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GENERAL SCIENCE.—*Science in the Department of State.*[1] J. W. JOYCE, Deputy Science Adviser, Department of State. (Communicated by Walter Ramberg.)

I am sure that this audience needs no reminder of the vital role that science and technology plays in shaping the affairs of our daily lives. We expect science and technology not only to take a major part in providing most of the material things we associate with modern civilization but also to produce a steadily increasing standard of living. We depend heavily upon science and technology to build strong military forces to safeguard our national security. It is not surprising therefore to find that science is becoming inevitably and inexorably interlinked with the affairs of government. There are many indications of this. We find, for example, that scientists and engineers are to an increasing extent being placed in high positions in government—positions that involve broad policy planning, as distinguished from what might be termed tactical planning. Other evidences are found in the marked increase in federal budget items designated for research and development since the pre-World War II period and in the creation of new agencies and establishments with responsibilities in the field of science since World War II. These include the National Science Foundation, the Interdepartmental Committee for Scientific Research and Development, the Research and Development Board in the Department of Defense, and the Office of the Science Adviser in the Department of State.

This evening I should like to tell you a little more about this last-named organization, outlining some of the factors which led to its establishment, recounting some of its accomplishments to date, and venturing some opinions regarding its future.

The relationship between science and foreign affairs is, perhaps, less apparent than in a number of the more obvious cases just mentioned. E. M. Friedwald, writing in *Impact*, has put it as follows:

> The conduct of foreign affairs has always been a traditional preserve of conservatism. But science is not conservative. This perhaps explains in some measure why science, which has lately infiltrated into so many spheres of government activity, has made so little headway in penetrating into the field of foreign affairs. Few are the embassies and legations which do not have their military, naval, air, commercial, and press attaches; but science attaches of a comparable status could until recently be counted on the fingers of one hand.

In 1947, in an effort to continue the excellent scientific liaison with our British colleagues that had been built up through the war years, the Department of State embarked on what was then considered a rather unusual venture in Foreign Service operations. It placed in the American Embassy in London a small science group, staffed by American scientists of established reputation, each serving for a period ranging from three months to a year or more. This operation proved quite successful, and in all some 12 or more scientists served at various times on this staff, although usually there were not more than two in the Embassy concurrently. While the venture proved reasonably successful, the fact that even greater results were not realized was undoubtedly due to the lack of a formal supporting organization in the Department in Washington. It was only through the very commendable efforts of a small number of individuals in the Depart-

[1] Address delivered at the annual meeting of the Washington Academy of Sciences on January 15, 1953.

ment who undertook to backstop this operation as more or less extra duties that any effective assistance was extended to the London staff.

THE BERKNER REPORT

In 1949 the Department of State made a series of studies to determine a suitable reorganization plan to bring its structure into conformity with recommendations made by the Hoover Commission. One of the task force groups that dealt with these matters reported that

> The Department is dealing on the one hand with foreign policy matters which have a great effect upon United States scientific policy and on the other hand with international scientific activities which have an impact on foreign policy. These matters are being handled at various points without adequate scientific evaluation. . . .

There followed a recommendation that the Department select a scientist of national reputation to serve as a temporary consultant to determine and made recommendations on, first, the role of the Department in national scientific policy, and second, appropriate organization and staffing required to carry out its responsibilities.

Following the approval of this recommendation, Dr. Lloyd V. Berkner, of the Carnegie Institution of Washington, was appointed as a special consultant to the Department of State in October 1949. He was given the task of examining the whole question of science and foreign relations and of making recommendations concerning the Department's responsibilities in connection therewith. The resulting survey produced the Department of State report *Science and foreign relations*, which was released in May 1950.

The Berkner report, as this publication has since been called, sought to answer two important questions: the first, How can the potentialities of scientific progress be integrated into the formulation of foreign policy and the administration of foreign relations so that the maximum advantage of scientific progress and development can be acquired by all peoples?; the second, How can foreign relations be conducted in such a manner as to create the atmosphere that is essential to effective progress of science and technology? The report went on to recommend that United States foreign relations with respect to science and technology must take on a more positive and active character than had existed in the past. Policy makers must become aware of the scientific implications of their decisions as well as a means of obtaining sound evaluation of these implications.

The entire field of science and foreign relations was clearly too broad in its scope to permit effective exploration in a reasonable time and with available effort. It soon became apparent that a most important part of this whole field was the interchange of unclassified, openly available, scientific information. This, then, was to be the limited objective of the survey—and within this framework could be included exchange of publications and manuscripts, exchange of persons, attendance at international meetings, and similar operations through which scientific and technical information might be exchanged. It was further realized that perhaps the greatest need from the United States' point of view lay in acquiring basic or fundamental scientific information from abroad and, accordingly, this aspect received initially the greatest consideration.

OFFICE OF THE SCIENCE ADVISER AND SCIENCE STAFFS ABROAD

In particular, the report recommended that a small office be established within the Department of State to be designated as the Office of the Science Adviser. It also recommended that small science staffs be established at certain American posts abroad. This report was adopted by the Department, and in February 1951 there came into existence on a formal basis the Office of the Science Adviser, reporting directly to the Under Secretary of State. In June and July of that year science staffs were placed in our missions in Stockholm and Bern, and the London staff, which had been continuing on an ad hoc basis since 1947, was augmented.

In February 1952 a science staff was constituted in Paris, and in August of last year two science advisers were sent to the office of the United States High Commissioner for Germany at Bonn. In the

summer of 1952, the staff at Bern was withdrawn temporarily, leaving at the present time science attaches in our missions at London, Stockholm, Paris, and Bonn.

The Office of the Science Adviser in the Department of State serves three functions:

1. It introduces science, through collaboration with Department officers, where it is a factor to be considered in foreign policy formulation and administration. On some occasions it takes the initiative to encourage the Department to give proper consideration to the scientific implications of policies—implications that might otherwise go unrecognized. On other occasions it provides scientific evaluation and advice when requested for the development and effectuation of Department policies. Except for atomic energy matters, the Office of the Science Adviser alone within the Department carries these responsibilities and maintains the necessary science liaison with government agencies, private scientific institutions, industrial laboratories, and individual scientists in this country and, through the science attaches, abroad.

2. It helps to conduct foreign relations for the advancement of science in this country through its familiarity with the objectives and interests of American scientists. As I have already said, our national well-being and security are largely dependent upon our scientific progress. This progress in turn depends mainly upon those results of fundamental scientific research that become available to American scientists from whatever source. As Karl Compton observes, "Our outstanding American genius thus far has not been in scientific discovery, but has been in the combination of what is termed Yankee ingenuity and mass production and distribution . . . When it comes to scientific discovery . . . America is not unique. Its achievements are respectable and its scientific stature has grown very rapidly. I would venture the statement that in the field of science the United States is the equal of any other nation, but this is very far indeed from saying that the United States has a scientific monopoly, or even a scientific majority."

By promoting the international exchange of scientific information, encouraging friendly relations with foreign scientists, helping to coordinate our scientific programs, and generally assisting scientists here and in friendly countries abroad through the conduct of our foreign relations the Department contributes to the advancement of science and therefore to our national well-being and security.

3. It carries out coordinating functions. Thus, the Office of the Science Adviser is responsive to the foreign scientific information needs of government agencies engaged in research, where such needs can be met from openly available sources. It is the central point in the Department for coordinating the foreign scientific activities of other government agencies, such as the National Science Foundation, within the framework of our foreign policy.

Within the missions abroad the science staffs perform much the same functions as does the Office of the Science Adviser within the Department. The attache brings to the attention of the appropriate officers of the mission those scientific matters which should be given consideration. He also acts as adviser to the Chief of Mission and divisions of the mission on matters pertaining to science. In addition, he performs important representational functions.

Essentially then, the Science Adviser and the attaches represent science as far as the State Department and the foreign missions are concerned, and at the same time, represent the State Department in its relations with science in this country and abroad. These functions serve to maintain a desirable closer relationship between foreign relations and science.

RECENT ACCOMPLISHMENTS

During the 20-odd months since the formal establishment of the Office of the Science Adviser a wide variety of problems have been dealt with. Experience has shown that there are indeed few areas within the Department of State that do not at some time or other deal with matters which include scientific aspects. Consider for example the field of traditional Foreign Service reporting. While a 2-man science staff in an embassy abroad cannot in any sense of the word hope to cover all fields of

science and technology in a given country, it can be most helpful in meeting a limited number of requests for specific information. These might include progress reports on certain projects prior to publication. In other cases, attaches may encounter items which they believe will be of interest to American science. In all such cases the attache would always first receive permission from the investigator to return the information to this country for distribution to American science.

The immediate postwar period witnessed distressing delays in scientific publication due to shortages of one kind or another, combined with imposing backlogs of manuscripts. Under these circumstances spot reporting took on added significance in expediting the exchange of scientific information. Now, however, publication has caught up, and reporting can therefore be confined to the more or less special cases. Even in these instances the operations are usually directed in such a manner that at the earliest possible moment the source and the end-user can be brought together directly so that normal exchange arrangements can be set up without the Department of State as an intermediary.

In addition to the conventional exchange of printed or manuscript reports, there are the very important kinds of operations which brings scientists into direct personal contact with each other. These include all of the exchange programs involving professors, research investigators, and students, and the attendance at international scientific and technological conferences and congresses.

In the exchange programs, the science attaches in the field have rendered valuable assistance in serving as members of the review boards which make the initial judgment on exchange projects. The Office of the Science Adviser has on numerous occasions helped to plan itineraries for visiting scientists coming from foreign countries. This office has also been able to notify our embassies and missions overseas when American scientists plan trips in those cases where we have been advised of such plans in advance. While, due to limited staffs, it is not possible to offer complete travel and accommodation services for all scientific people going abroad, a certain amount of help can be extended in cases of real emergency.

Another important operation of the science office is in serving as a focal point in the Department for the consideration of official representation at scientific international meetings. This has made it possible to assure the selection of groups of official delegates who are best suited professionally to represent American science at international meetings. There have been in the past unfortunate cases where the selection of candidates was made on the basis of their convenient presence at or near the meeting place at the time of the meeting rather than on scientific qualifications. A greater awareness of the needs of American science has resulted in a modest increase in the financial support given to official delegations to international non-governmental scientific meetings, although it is recognized that additional aid of this kind would be most desirable.

Finally the Office of the Science Adviser and the science attaches overseas have done what they could to be of assistance to the officers in the Department and to consular officers in the field responsible for the administration of the visa laws to the end that the national interests can best be served in those cases which involve scientists.

LIAISON WITH NATIONAL ACADEMY OF SCIENCES–NATIONAL RESEARCH COUNCIL

At this point I should like to acknowledge the great assistance that the National Academy of Sciences–National Research Council has rendered to the Department of State in serving as the contact point with American science outside of government. During the writing of the Berkner report the Academy-Council, at the request of the Department, appointed a liaison member to the special survey group. It also appointed a special committee to critically review the manuscript of the report prior to its publication. The Academy-Council clearly recognized its vital role as intermediary between State and American science in general. To carry out this task, it expanded its facilities to include an Office of International Rela-

tions. Through this office the Department receives, for example, recommendations for the selection of official delegations to scientific meetings; it obtains aid in dealing with specific problems through the availability of the services of individual members of the Academy-Council and its various divisions and committees; it makes possible the distribution to American science outside of the government of unclassified scientific information received from science attaches overseas.

RECRUITMENT OF SCIENCE ATTACHES

Now a word as to the staffing pattern that has been followed for the overseas missions. Traditionally, the ground for understanding between scientists has been a mutual recognition and respect for ability and accomplishment. This fact clearly suggested that to be most effective, producing scientists, preeminent in their field, should be selected for the overseas staffs. Such persons can expect to be accepted as colleagues and equals by the foreign scientific communities. The senior science attache in each post should be a man, therefore, combining scientific stature, mature judgment, tact in working with his colleagues and associates, and wherever possible, proficiency in the language of the country to which he is assigned. When one combines these characteristics in one person the result is a man whose services to his university or laboratory may almost be classed as indispensable and who is difficult to obtain even on a temporary basis. Our experience so far has shown that the most likely sources of such people are the universities. This has resulted in the acceptance of a 15-month tenure of duty, since it is usually possible to secure such people for a sabbatical year, with the preceding and succeeding summers. While this length of time is all too short to produce the maximum effectiveness from the overall point of view, we have felt that it is the most reasonable compromise, taking into consideration all of the aspects involved. If a producing scientist remains absent from his laboratory for a period of much more then two to three years, he may well lose touch with his field. This, then, sets the maximum limit as far as the scientist's own interests are concerned.

The whole problem of recruiting science attaches has proved to be a most difficult one during these first months of operation. Quite naturally a producing scientist is extremely hesitant to leave a laboratory for an assignment as a science attache unless he is convinced that he can do a useful job. The very high standards which have been set for science attaches add further to the difficulties of finding people. Nevertheless, the results obtained so far through the selection of such preeminent persons have, it is felt, completely justified the staffing pattern chosen. It is our hope that as the operation continues it will become better known among scientists, and further there will be built up an "alumni" of science attaches who will be willing to return for reassignment during subsequent years. In addition, former science attaches who have found the assignment interesting and profitable can pass the word to their colleagues.

CONCLUSION

In conclusion, I should say that the accomplishments of the Office of the Science Adviser and the overseas staffs have more than justified their existence. Certainly, if work load is any measure of need, this is true. In addition to the day-to-day operations which result in the transmission of specific items of scientific information, and the various other services described, there is, I believe, a much more valuable benefit which, at the moment, may be termed intangible, but which in later years can be extremely productive in terms of concrete results. I refer to the improvement in the traditional understanding between scientists in America and abroad which this operation will engender. In such an atmosphere, we are far more likely to learn promptly from our colleagues in other countries of significant discoveries in science, discoveries which, combined with American initiative and production ability, can add materially to our national welfare and security.

ENGINEERING.—*Dynamic stress-strain curves for mild steel using the tangent modulus procedure.* WILLIAM R. CAMPBELL, National Bureau of Standards. (Communicated by Walter Ramberg.)

In this note the author wishes to report on some dynamic stress-strain curves for mild steel obtained by the tangent modulus procedure. This procedure was described in detail in a paper recently presented before the Society for Experimental Stress Analysis (*1*). Briefly, a long bar is subjected to longitudinal impact, and the strain traveling up the bar is measured directly as a function of time with wire strain gages. The stress can not be measured directly by any means known to the author. It is determined indirectly by integration of the tangent modulus or slope of the stress strain curve. This slope is proportional to the square of the velocity of propagation of the strain considered, as pointed out some years ago by Donnell (*2*) and von Karman (*3*). The velocity of propagation was measured directly by comparing carefully synchronized strain signals from wire strain gages spaced a known distance apart along the bar under impact. It should be noted that the procedure of integration rests on the assumption that only one stress-strain curve applies at the strain rates of the test.

Preliminary tests on copper reported in (*1*) were afflicted with a large scatter, but within this scatter the stress-strain curves under impact coincided with that obtained in the conventional static tensile test. In the meantime the testing technique has been improved and the tests have been extended to mild steel, which differs from copper in having an upper and lower yield point and in showing a peculiar delay in yielding under suddenly applied stress (*4*).

Fig. 1 shows static and dynamic stress-

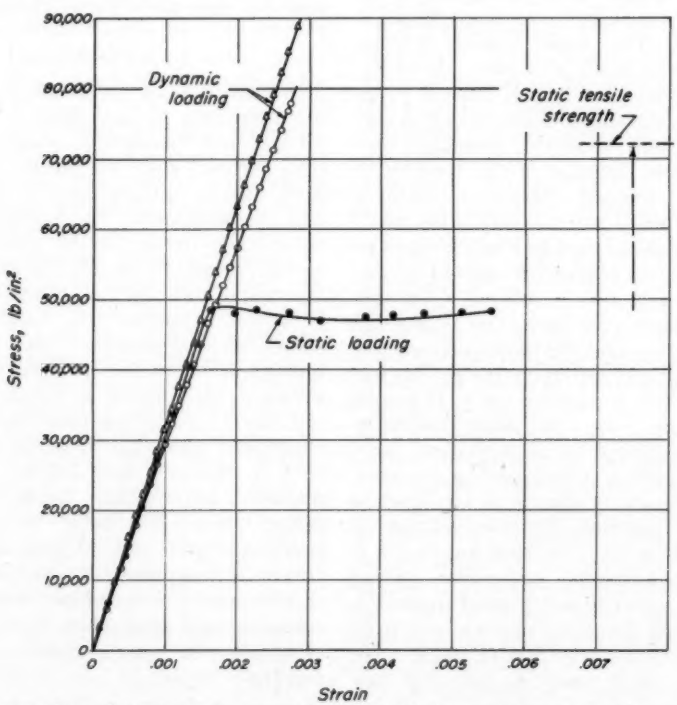

FIG. 1.—Comparison of stress-strain curves for static loading and dynamic loading of mild steel. (Velocity of impact = 57 ft sec. Time to maximum strain = 35×10^{-6} sec.)

strain curves obtained by the above procedures for three similar specimens of hot rolled mild steel. Two of the test bars were subjected to longitudinal tensile impact at an impact velocity of 57 ft/sec. Neither bar exhibited any plastic strain for the largest strains recorded or showed any discontinuity in the dynamic curve in the vicinity of the sharply defined static yield point. It is also significant that the maximum stresses generated did not cause failure in in either bar even though these stresses exceeded the static tensile strength.

Obviously, rates of straining of the order of 150 per second applied in the longitudinal impact test have a pronounced effect on the stress-strain curve for mild steel. The shape of the stress strain curve of mild steel beyond the elastic range would be of great interest in view of the importance of this material. It would require not only further tests with impacts of various rise times but also a generalization of the tangent modulus procedure to make it applicable to the determination of the family of stress-strain curves for various strain rates. Such work is being planned in the Engineering Mechanics Section of the National Bureau of Standards.

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PALEONTOLOGY.—*A new prionodont pelecypod genus*. DAVID NICOL, U. S. National Museum.

In 1944 Olsson (pp. 50–51) described a new species of pelecypod which he named *Cardium (?) abnormalis*. The description was based on one left valve from the Upper Cretaceous of the Paita region, Peru. The hinge was not exposed, and the specimen also lacked other diagnostic morphologic characters. Recently Dr. Olsson received two more left valves from Colombia which he gave me to describe. One specimen had a part of the hinge teeth and ligament exposed. Both of these parts of the shell resemble *Glycymeris*, but some other morphologic characters are unusual. After careful preparation and examination, I believe that the specimens represent an undescribed genus.

Pettersia Nicol, n. gen.

Type species.—*Cardium (?) abnormalis* Olsson.

Remarks.—This genus is named for Dr. V. Petters, micropaleontologist for the International Petroleum (Colombia) Ltd., who released two additional left valves for study.

Pettersia abnormalis (Olsson), 1944

Figs. 1–5

Cardium (?) abnormalis Olsson, Bull. Amer. Pal. **28** (111): 50–51, pl. 17, fig. 3. 1944.

Description.—Part of Olsson's original description is as follows:

> The shell is of medium size with a *Fragum*-like form and a thick, solid texture; umbo high, wide, ending above in a small prosogyrate beak; umbonal ridge high, angled, the dorsal-posterior area well defined and divided by a groove in the middle, the outer portion being flattened while the inner or side next the hinge is arched or vaulted; a deep furrow or groove extends from the ventral margin upwards towards the beak but is only faintly indicated on the umbo; surface is smooth except for irregularly distributed growth lines which at intervals are grouped together in resting marks; ventral margin crenulated; hinge unknown.

With the two additional left valves given me by Olsson, I can add the following information to the description: The duplivincular ligament consists of five symmetrical chevron-shaped grooves as in *Glycymeris*. The hinge teeth, 34 in number, are symmetrically arranged in an arc on a moderately heavy hinge plate, the side teeth being longer than the central teeth; these teeth are typically like those of a prionodont pelecypod (*Glycymeris*, *Trigonarca*). The anterior adductor muscle scar is small, situated just below and posterior to the anterior end of the hinge plate; the posterior adductor muscle scar is relatively small, situated on a prominent buttress or flange

below the posterior end of the hinge plate. Like the flange or buttress for the posterior adductor muscle of *Cucullaea*, this flange runs anteriorly toward the umbo. The ornamentation consists of small, closely spaced radial ribs which are somewhat beaded. The most characteristic feature is the large sulcus, which runs from the umbonal region to the ventral border. The sulcus is located along the posterior third of the shell. Posterior to the sulcus is a high ridge, and the posterior end of the shell is flattened and truncated. The sulcus is seen in other prionodonts, but it is rarely so prominent on mature specimens. Young specimens of *Cucullaea* and *Anadara* also show this feature. The sulcus is more prominent on species of *Arca*, where it is usually connected with the byssal notch. It is problematical whether *Pettersia* was attached by a byssus, and it will remain so until a specimen of a right valve is examined.

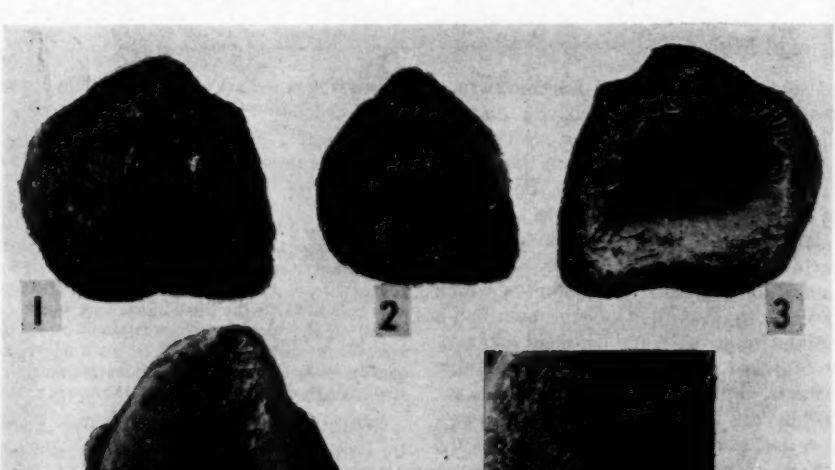
The largest specimen has a high umbo and a tall ligamental area. The beak is located above and at approximately the center of the ligamental area. Olsson states that the beak is prosogyrate, but the material I have examined does not definitely confirm this; it appears to be orthogyrate or, at most, only slightly prosogyrate.

The hinge teeth of *Pettersia* resemble those of *Glycymeris*, *Peruarca*, and *Trigonarca*. The ligament resembles that of *Glycymeris* and *Trigonarca*, and the crenulated margin is similar to that of *Glycymeris*. The buttress for the posterior adductor muscle, the ornamentation, the shape of the shell, and the crenulated ventral margin are like those of many of the Cucullaeidae. However, *Pettersia* differs from these genera in having a very deep sulcus along the posterior third of the shell.

Measurements.—As follows (left valves):

	Height	*Length*	*Convexity*
Holotype, P. R. I. no. 4862.....	36.0	32.0	17.0
Hypotype, U. S. N. M. no. 108690.....	40.4	41.8	19.0
Hypotype, Olsson Collection.....	53.9	48.2	23.7

Locality data.—The holotype came from Tortuga, Paita region, Peru. The hypotypes (personal communication from Olsson) came from



FIGS. 1–5.—*Pettersia abnormalis:* 1, Exterior view, hypotype, U.S.N.M. no. 108690; 2, exterior view, holotype, P.R.I. no. 4862; 3, interior view, same specimen as in Fig. 1; 4, exterior view, hypotype, A. A. Olsson Collection; 5, exterior view showing ornamentation, × 2, same specimen as in Fig. 4. All figures are of left valves. Figures 1–4 are all × 1. Holotype is from Maestrichtian of Paita region, Peru. Hypotypes are from Maestrichtian of upper part of Magdalena Valley, Colombia.

the Upper Magdalena Valley, west side, south of Girardot, 3,300 meters east of El Valle and 7,500 meters north of San Luis, in a small affluent of the Río Luisa, near a house called El Dinde, Tolima Province, Colombia.

Age.—The holotype came from the *Baculites* zone, Maestrichtian stage, Upper Cretaceous. The hypotypes (personal communication from Olsson) were found in a shell bed in a band of sandy limestone 10 meters below a thin ridge of quartz pebble conglomerate. *Pettersia abnormalis* is associated with Foraminifera of the Maestrichtian stage, including *Siphogenerinoides bramlettei* Cushman and Hedberg.

ACKNOWLEDGMENTS

I am particularly indebted to Dr. A. A. Olsson, of Coral Gables, Fla., who sent me specimens for study and asked me to describe the new genus. Dr. Katherine V. W. Palmer kindly allowed me to borrow the holotype of *Cardium* (?) *abnormalis* from the collection at the Paleontological Research Institution, Ithaca, N. Y. Wm. T. Allen, of the U. S. National Museum, made the photographs for the paper.

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PALEONTOLOGY.—*A new cárpoid from Oklahoma.* HARRELL L. STRIMPLE, Bartlesville, Okla. (Communicated by Alfred R. Loeblich, Jr.)

The new carpoid described below was found on a field expedition into the Criner Hills of southern Oklahoma made in the spring of 1950 by Mrs. Melba Strimple, Richard Alexander, and the author. An undescribed species of *Archaeocrinus* and *Hybocrinus crinerensis* Strimple and Watkins have been obtained from the same zone.

Myeinocystites, n. gen.

Theca is compressed, slightly convex in midsection of one side, and mildly concave on the opposite side. Following the morphological terminology of Bather (1900), the convex side is considered to be the right side and the apposing to be the left side. In the right side, there are 10 plates forming a marginal rim, or frame, and one is smaller than the others, being located in the extended lower right corner of the theca. Three of the marginal plates adjoin the stem. Within this marginal rim there are three large plates, and one small plate to the lower right. A small cluster of plates, resting in a notch between the two uppermost marginal plates, apparently marks an opening into the body cavity, probably a hydropore.

The left side is more complex. Marginal plates of the right side are curved sharply over to form the frame of the left side. Two additional plates are in contact with the stem, and 19 plates are present within the frame. A single small biserial arm rises in the marginal portion of the oral end of the theca and occupies a groove extending downward. To the left of its proximal extremity is found a long tubelike structure which appears to be an opening into the body cavity, though the function is a matter of conjecture. Immediately above the base of the arm there is a small cluster of plates, previously noted on the right side. A canal originates to the right of the arm base and follows the marginal rim past another opening to the right (probably the anus) and appears to terminate on a convex plate just below midheight of the theca. The proximal portion of the above-mentioned convex plate terminates abruptly, forming a sharp notchlike structure which might represent another opening into the body cavity (? a primitive pore-rhomb). The opening which lies to the right of the arm is covered by seven minute plates which converge toward the center.

The stem is wide, composed of thin columnals which do not form complete circlets owing to interruption by laterally directed sutures on the left side.

Surface ornamentation consists of heavy granules, or minute pustules, which do not form any definite pattern. They are more pronounced on the right side and are entirely absent on the arm, covering plates of the body openings, and in the canal of the left side.

Genotype species.—*Myeinocystites natus*, n. sp.

Occurrence.—Bromide formation, Ordovician; North America.

Remarks.—The presence of a canal is not without precedence among the Anomalocystidae. In *Trochocystites* Barrande (1859) such a canal is reported running round the thecal cavity on the inside of the marginals. Three openings are pres-

ent in that genus, one in the center of the oral end of the frame (? hydropore and gonopore) and one each to the right and left. Bather (1900) considered one to be the mouth and the other the anus, with question.

Belemnocystites Miller and Gurley (1894) appears to be more comparable to *Myeinocystites* than to other described forms. Unfortunately the specimens available to Miller and Gurley were damaged by silicification and the openings obliterated. Under critical comparison significant differences are readily apparent. The plates of the marginal rim cover an equal portion of both the right (dorsal) and left (ventral) sides in *Belemnocystites*, whereas in *Myeinocystites* only their edges are present on the left side. There are four large plates within the marginal rim of *Belemnocystites* in the right side, and no downward extension of the theca is present. In the present form there are three large plates within the frame, with a fourth, smaller plate in the downward extension of the theca. The plates within the marginals in the left side are more numerous in *Myeinocystites*, which in itself indicates a more primitive form.

Myeinocystites natus, n. sp.
Figs. 1, 2

The theca is compressed, subovoid in outline, 18.3 mm in length by 14.4 mm wide. Midportion of the right side is mildly convex, and the left side is shallowly concave. Ten plates form the marginal rim of the right side, three of which are adjacent to the column. Four plates are present within the marginals. In the left side there are 21 plates within the frame. A single arm is composed of some 24 long, narrow, interlocking brachials and reposes in a groove in the upper portion of the left side of the theca. Just above the base of the arm there is a small pyramid of plates which probably marks an opening into the body cavity (? hydropore). A well-defined opening (? anus) is present to the right of the arm and is connected to the (?) hydropore by a narrow canal which follows the inner edges of the marginals. The canal continues past the (?) anus which opening is covered by seven minute plates. A tubelike extension is present to the left of the proximal tip of the arm, and probably represent an opening into the body cavity.

The entire surface of the theca and column is covered by minute pustules with the exception of the arm, covering plates of the body openings, and the canal. They are more pronounced on the right side and tend to form small spines on the column.

Remarks.—This species is more comparable to *Belemnocystites wetherbyi* Miller and Gurley than to other described forms. Intimate comparison is impossible due to the incomplete preservation of specimens referred to that species; however, some readily discernible differences are noted. Viewed from the right side there are nine plates in the marginal rim (excluding plates in contact with the stem) of *B. wetherbyi*, four to the left and five to the right. In *M. natus* there are only three to the left and five to the right, one of which is a small plate in the downward extension of the theca. There is no extension of the theca in proximal regions, either to the right or left, in *B. wetherbyi*. There are fewer plates, within the frame of *B. wetherbyi*, in the left side than found in the present species.

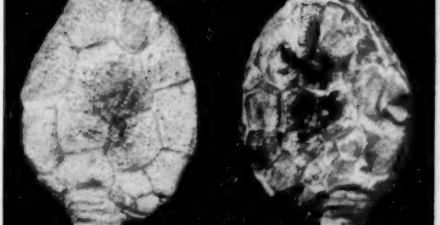
It is interesting to note that Wetherby, as well as Miller and Gurley, noted the presence of a small node to the left of the arm and surmised the existence of an opening into the body cavity. It is almost certain that the tubelike extension of *M. natus*, which is in that area, represents an opening.

Occurrence.—Bromide formation, Ordovician; bank of Spring Creek, a tributary of Hickory Creek, north of an exposure on Hickory Creek commonly known as "Rock crossing," Criner Hills, southwest of Ardmore, Okla.

Type.—Collected by H. L. Strimple. To be deposited in the U. S. National Museum.

REFERENCES

All cited references are listed in Bassler and Moody, *Bibliographic and faunal index of Paleozoic Pelmatozoan Echinoderms*, Geol. Soc. Amer. Spec. Pap. 45. 1943.



FIGS. 1–2.—Holotype of *Myeinocystites natus*, n. gen., n. sp., from right, and left sides, ×2.

BOTANY.—*Critical notes on the genus* Symplocos *in Formosa.* HUI-LIN LI, Morris Arboretum, University of Pennsylvania.

The genus *Symplocos* is represented by over 20 species in Formosa. Some of the species are important elements of the broad-leaved forests at medium and high altitudes in various parts of the island.

There are two recent works dealing with the genus as occurring in Formosa. Mori, Sylvia **6**: 1–35. 1935, presents a classification of the species based on leaf-characters only, enumerating 34 species. Kanehira's treatment, Formosan Trees, rev. ed. 579–602. 1936, is the most extensive, and in it 30 species are keyed. Most of the species are described and illustrated, but a few inadequately known species are listed by name only.

The works of these and other Japanese authors are based mainly on local material, without adequate reference to the closely related floras of neighboring regions especially the Chinese mainland and the Philippines. Consequently the incidence of endemism, as interpreted by these authors, is considered exceptionally high. For the same reason the nature of some of the widely distributed species is not properly understood, and thus too many species are recognized by slight and trivial variations of little or no taxonomic value.

A critical study of the Formosan species was made with the aid of large reference collections of Asiatic plants in the herbarium of the U. S. National Museum, Smithsonian Institution, representing all the neighboring floras of Formosa, especially the closely related ones of the Chinese mainland, Hainan Island, the Liukiu Islands, the Philippine Islands, and Japan. As a result, it is revealed that many of the widespread species of eastern Asia, particularly those of the Chinese mainland, extend also to Formosa. Many species are found to be not endemic to the Formosan flora but only synonyms of these species of wide ranges. The many duplicate synonyms also prove that fewer species are actually to be found in Formosa. These taxonomic notes are herein presented. Cited specimens are selected from the U. S. National Museum (indicated by US), the herbarium of the National Taiwan University, Formosa (indicated by NTU), and the herbarium of the Taiwan Forestry Institute (indicated by TFI).

1. **Symplocos caudata** Wall. List no. 4413. 1830, nomen; A. DC. in DC. Prodr. **8**: 256. 1844.
   Symplocos prunifolia Sieb. & Zucc. in Abh. Akad. Wiss. Muench. **4**(3): 133. 1846.
   Symplocos sasakii Hay. Icon. Pl. Formos. **5**: 114. *f. 36.* 1915; Mori in Sylvia **6**: 27. *f. 27.* 1935; Kanehira, Formos. Trees, rev. ed. 598. *f. 555.* 1936. *Syn. nov.*
   Symplocos somai Hay. Icon. Pl. Formos. **9**: 69. 1920; Mori in *op. cit.* 28. *f. 28*; Kanehira, *op. cit.* 599. *f. 556. Syn. nov.*
   Symplocos sozanensis Hay. *op. cit.* **9**: 70. 1920; Mori in *op. cit.* 28. *f. 29*; Kanehira, *op. cit.* 599. *f. 600. Syn. nov.*
   Bobua sasakii Kanehira & Sasaki in Sasaki, List Pl. Formos. 332. 1928. *Syn. nov.*
   Bobua somai Kanehira & Sasaki in *loc. cit. Syn. nov.*
   Bobua sozanensis Kanehira & Sasaki in *loc. cit. Syn. nov.*

Common and widespread in eastern Asia, from the Himalayas eastward to Japan; Formosa, common in forests throughout the island.

Formosa: Mount Syabozan, Taihoku-syu, *G. Masamune 2762* (NTU); Zyukirin, Sinitiku, *Soma 19770* (isotype of *S. somai* Hay. TFI, photo US); Sozan, *Simada 19773* (isotype of *S. sozanensis* Hay. TFI, photo US).

The reduction of the three species of Hayata to this widespread and common species of eastern Asia is based on type specimens as well as the original descriptions.

2. **Symplocos cochinchinensis** (Lour.) Moore in Journ. Bot. **52**: 148. 1914.
   Dicalyx cochinchinensis Lour. Fl. Cochin. 663. 1790.
   Symplocos ferruginifolia Kanehira in Trans. Nat. Hist. Soc. Formos. **20**: 383. 1930, Formos. Trees, rev. ed. 585. *f. 542.* 1936. *Syn. nov.*

Southern China and Indo-china; Formosa, northern part of the island.

I have seen no isotype of Kanehira's species, but his detailed descriptions and illustration clearly indicate the identity of his species with the widespread *S. cochinchinensis* of the mainland.

3. **Symplocos congesta** Benth. Fl. Hongk. 211. 1861.
   Symplocos adinandrifolia Hay. Icon. Pl. Formos.

5: 93. 1915; Mori in Sylvia **6**: 16. *f. 1*. 1935; Kanehira, Formos. Trees, rev. ed. 579. *f. 537*. 1936. *Syn. nov.*

Symplocos adinandrifolia var. *theifolia* Hay. *op. cit.* 95. *f. 24*. *Syn. nov.*

Symplocos nakaii Hay *op. cit.* 110. *f. 25e*. *Syn. nov.*

Symplocos phaeophylla Hay. *op. cit.* 111. *f. 34*. Mori in *op. cit.* 26. *f. 25*. Kanehira, *op. cit.* 739. *Syn. nov.*

Symplocos hayatae Mori in Trans. Nat. Hist. Soc. Formos. **24**: 193. 1934; in Sylvia **6**: 21. *f. 12*. 1935. *Syn. nov.*

Symplocos kudoi Mori in Trans. Nat. Hist. Soc. Formos. **24**: 193. 1934; in Sylvia **6**: 24. *f. 18*. 1935; Kanehira, Formos. Trees, rev. ed. 594. 1936. *Syn. nov.*

Bobua adinandrifolia Kanehira & Sasaki in Sasaki, List. Pl. Formos. 330. 1928. *Syn. nov.*

Bobua nakaii Kanehira & Sasaki in *op. cit.* 331. *Syn. nov.*

Bobua theifolia Kanehira & Sasaki in *op. cit.* 332. *Syn. nov.*

Bobua phaeophylla Kanehira & Sasaki in *op. cit.* 332. *Syn. nov.*

Symplocos prunifolia sensu Hay. in Journ. Coll. Sci. Tokyo **30**(1): 188. 1911 (Mat. Fl. Formos.), non Sieb. & Zucc.

Symplocos theifolia sensu Hay., Icon. Pl. Formos. **6**: 29. 1916, non D. Don.

Widely distributed in southern China; Formosa, common in forests, central to southern part of the island.

Formosa: Rengechi, Taityu, *S. Hibino & S. Suzuki*, July 18, 1930 (NTU); Central Range, *Mori 19755* (isotype of *S. adinandrifolia* Hay. TFI, photo US).

Several of the above mentioned names such as *S. nakaii* Hay. and *S. hayatai* Mori, were reduced to the synonymy of *S. adinandrifolia* by Kanehira and others. *Symplocos kudoi* Mori is known only from the type from central Formosa. *Symplocos phaeophylla* Hay. is based on a Kanehira collection of unknown locality. The specimens have not been seen. Judged from the original descriptions and illustrations, these two names, together with *A. adinandrifolia*, all belong to *S. congesta*, a species of wide occurrence on the China mainland.

4. **Symplocos lancifolia** Sieb. & Zucc. in Abh. Akad. Wiss. Muench. **4**(3): 133. 1846.

Symplocos arisanensis Hay. in Journ. Coll. Sci. Tokyo **30**(1): 187. 1911 (Mat. Fl. Formos.); Icon. Pl. Formos. **2**: 120. *f. 19*. 1912; Mori in Sylvia **6**: 17. *f. 2*. 1935; Kanehira, Formos. Trees, rev. ed. 582. *f. 538*. 1936. *Syn. nov.*

Symplocos suishanensis Hay. Icon. Pl. Formos. **5**: 116. *f. 39*. 1915; Mori in *op. cit.* 29. *f. 30*. 1935; Kanehira, *op. cit.* 601. 1936. *Syn. nov.*

Bobua arisanensis Kanehira & Sasaki in Sasaki, List. Pl. Formos. 330. 1928. *Syn. nov.*

Southern China to Japan; in Formosa, at high altitudes in the central ranges.

Formosa: Mount Taheizan, *S. Suzuki*, Aug. 4, 1928 (NTU); *E. H. Wilson 10173* (US), *10222* (US); Arisan, *E. H. Wilson 9715* (US); Arisan, *Kawakami & Mori 19653* (isotype of *S. arisanensis* Hay. TFI, photo US); Arisan, Suisyaryo, *Hayata, Kanehira & Tanaka 19783* (isotype of *S. suishanensis* Hay. TFI, photo US).

Type specimens and descriptions as well as illustrations have shown that Hayata's two species are undoubtedly the same as *Symplocos congestus* Benth., widespread from southern China to Japan.

5. **Symplocos laurina** Wall. List no. 4416. 1830.

Symplocos wikstroemifolia Hay. Icon. Pl. Formos. **5**: 119. *f. 25b*. 1915; Mori in Sylvia **6**: 30 *f. 34*. 1935; Kanehira, Formos. Trees, 602. *f. 506*. 1936. *Syn. nov.*

India to western and southern China; Formosa, in forests, central and southern parts.

Formosa: Mount Taiheizan, *S. Suzuki*, April 1, 1928 (NTU), *E. H. Wilson 12024* (US); Mt. Hassen, Taityu, *Sasaki 19804* (photo, US).

Reduction of *S. wikstroemifolia* is based on the original description.

6. **Symplocos modesta** Brand in Engl. Pflanzenr. **6**(IV. 242): 66. 1901; Hay. Icon. Pl. Formos. **2**: 120. *f. 20*. 1912; Mori in Sylvia **6**: 25. *f. 21*. 1926; Kanehira, Formos. Trees, rev. ed. 595. *f. 551*. 1936.

Symplocos eriostroma Hay. Icon. Pl. Formos. **5**: 99. *f. 25, c*. 1915; Mori in *op. cit.* 19. *f. 8*. 1925; Kanehira, *op. cit.* 583. 1936. *Syn. nov.*

Bobua modesta Yamamoto, Suppl. Icon. Pl. Formos. **4**: 19. 1928.

Bobua eriostroma Kanehira & Sasaki in Sasaki, List. Pl. Formos. 330. 1928. *Syn. nov.*

Symplocos myrtacea sensu Matsum. & Hay. in Journ. Coll. Sci. Tokyo **22**: 230. 1906 (Enum. Pl. Formos.) non Sieb. & Zucc.

Endemic, in broad-leaved forests at high altitudes.

Formosa: Arisan, *E. H. Wilson 9648* (US), *G. Nakahara*, Nov. 1906 (US); Mount Noko, *H. H. Bartlett 6180* (US); Taririku-syu, Taito, *S. Sasaki 19739* (photo US).

• *Symplocos eriostroma* Hay., based on young flowering specimens collected by Sasaki from Arisan, is reduced to *S. modesta* on the basis of the original description.

7. **Symplocos mollifolia** Dunn in Kew Bull. Add. Ser. **10**: 163. 1912.

Symplocos trichoclada Hay. Icon. Pl. Formos. **5**:

118. *f. 25.* 1915; Mori in Sylvia **6**: 30. *f. 32.* 1935; Kanehira, Formos. Trees, rev. ed. 601. *f. 559.* 1936. *Syn. nov.*
Bobua trichoclada Kanehira & Sasaki in Sasaki, List. Pl. Formos. 332. 1928. *Syn. nov.*
Symplocos trichoclada var. *koshunensis* Mori in Trans. Nat. Hist. Soc. Formos. **24**: 195. 1934, in Sylvia **6**: 30. *f. 33.* 1935. *Syn. nov.*

Southern China: Formosa, mountains in central and southern parts.

Formosa: Central Range, *Kawakami & Sasaki 19801* (isotype, TFI).

The type specimen and the original descriptions show that this Formosan plant is conspecific with *S. mollifolia* Dunn., a characteristic species from southern China.

8. **Symplocos patens** Presl. Rel. Haenk. **2**: 61. 1830.
Symplocos kotoensis Hay. Icon. Pl. Formos. **5**: 106. *f. 31.* 1915; Mori in Sylvia **6**: 23. *f. 17.* 1935; Kanehira, Formos. Trees, rev. ed. 593. *f. 584.* 1936. *Syn. nov.*
Bobua kotoensis Yamamoto, Suppl. Icon. Pl. Formos. **4**: 19. 1928. *Syn. nov.*

Luzon; Botel Tobago.

Formosa: Botel Tobago, *Kawakami & Sasaki 19719* (isotype of *S. kotoensis* Hay. TFI).

The type specimen of Hayata's species and his description and illustration clearly prove this to be conspecific with the Philippine species, *S. patens*, of the primary forests of Luzon.

9. **Symplocos setchuensis** Brand in Bot. Jahrb. **29**: 523. 1900.
Symplocos ilicifolia Hay. Icon. Pl. Formos. **5**: 102. *f. 29.* 1915; Mori in Sylvia **6**: 22. *f. 14.* 1935; Kanehira, Formos. Trees, rev. ed. 589. *f. 546.* 1936. *Syn. nov.*
Bobua ilicifolia Kanehira & Sasaki in Sasaki, List. Pl. Formos. 331. 1928. *Syn. nov.*

Widely distributed from western to central China; Formosa, in northern part of the island.

Formosa: Mount Hakko-zan, Toyen, *Mori 19702* (isotype, TFI).

Symplocos ilicifolia is known from a single collection in Formosa. This proves to be the same as *S. setchuensis* Brand of the mainland.

10. **Symplocos stellaris** Brand in Bot. Jahrb. **29**: 528. 1900.
Symplocos eriobotryaefolia Hay. Icon. Pl. Formos. **5**: 98. *f. 10.* 1915; Mori in Sylvia **6**: 19. *f. 7.* 1935; Kanehira, Formos. Trees, rev. ed. 584. *f. 541.* 1936. *Syn. nov.*
Bobua eriobotryaefolia Kanehira & Sasaki in Sasaki, List. Pl. Formos. 330. 1928. *Syn. nov.*

Widely distributed in central and southern China; Formosa, in forests at relatively high altitudes.

Formosa: Mount Daibu, Takao, *E. Matuda s. n.* (NTU).

This species is very close to *S. glauca* (Thunb.) Koidz., but is readily distinguished by the lamellate pith and the glandular-haired petals. The Formosan plant, showing also these distinctive characteristics, is in all respects identical with the species of wide occurrence on the mainland.

11. **Symplocos theophrastaefolia** Sieb. & Zucc. in Abh. Akad. Wiss. Muench. **4**(3): 134. 1846; Mori in Sylvia **6**: 29. *f. 31.* 1935; Kanehira, Formos. Trees, rev. ed. 601. *f. 558.* 1936.
Symplocos stenostachys Hay. Icon. Pl. Formos. **5**: 115. 1915.

China to Japan; Formosa, in broad-leaved forests, from low to high altitudes.

Van Steenis, in Bull. Bot. Gard. Buitenz. III. **17**: 432. 1948, considers *S. stenostachys* Hay. a synonym of *S. confusa* Brand. *Symplocos stenostachys*, described as having a long spicate inflorescence, is very distinct from *S. confusa* and has been correctly referred to the synonymy of *S. theophrastaefolia* Sieb. & Zucc. by Mori, Kanehira, and others.

ENTOMOLOGY.—*American species of* Ranatra annulipes *Stål group (Hemiptera: Ranatridae).* CARL J. DRAKE, Iowa State College, Ames, Iowa, and JOSÉ A. DECARLO, Museo Científico Natural, Buenos Aires, Argentina.

Almost a century ago the eminent Swedish hemipterist Carl Stål (1854, p. 241) very briefly described a new species of water-scorpion of the genus *Ranatra* Fabricius from Brazil under the scientific name *annulipes*. Seven years later (1861, p. 204) he redefined the species from the type and somewhat amplified his original description. In the latter article the length of the body and that of the respiratory filaments are given as equal. The characters employed in both descriptions are of little specific value in the separation of species.

After a lapse of nearly 50 years, the re-

nowned aquatic hemipterist A. Montandon (1905, pp. 393–395) of Rumania redescribed at considerable length the male type of *R. annulipes*, which was communicated to him by the director of the Stockholm Museum. Among the more important characters mentioned Montandon pointed out that the metasternum was very strongly developed, very highly elevated, longly narrowly produced posteriorly, and then terminated in an almost vertical curve between the hind pair of coxae. And from a lateral aspect, he also observed that the extremity of the last abdominal segment in the male was very strongly produced downward on each side so as to embrace the apex of the genital operculum. In the same article Montandon also determined as *R. annulipes* several specimens of water-scorpions from the widely separated regions of Novo Friburgo, Isthmus of Darien, Guadeloupe, and Jamaica. From the last three localities the writers have examined specimens bearing identification labels "*Ranatra annulipes* Stål" in Montandon's own handwriting. The specimens from each of the localities represented a different and an undescribed species.

In other papers Montandon (1907, p. 58; 1910a, p. 3; 1910b, p. 185), after studying the types (male and female) of *Ranatra fabricii* Guérin-Méneville from Cuba in the Museum of Zoology of the University of Naples, Italy, incorrectly synonymized this insect with *R. annulipes*. An examination of some Cuban material, determined and labeled by Montandon as *R. annulipes*, revealed that *R. fabricii* was a different species and readily distinguishable from the true *R. annulipes* from Brazil. On this account the writers are resurrecting *R. fabricii* and are treating it herein on the species level. Despite this confusion in differentiating species, Montandon (1907, p. 59) recognized and characterized a very distinct and closely allied species from Ecuador as *R. camposi*. In the same paper Montandon (1907, p. 58) also wrongly named a complex of several species from Panama, Colombia, Mexico, Guadeloupe, and Cuba as *R. annulipes*—none of which included the true *annulipes*.

Since the publication of the original description of *R. annulipes*, the literature is replete with numerous species wrongly named and confused with this insect. Besides *R. fabricii* and *R. ecuadoriensis* De Carlo, four of the five new species described and illustrated in this paper have been confounded in the literature with *R. annulipes*. Thus for several decades aquatic hemipterists have been lumping and confusing in the literature several unnamed species with similar general categories as described for *R. annulipes* under that specific name. From a general aspect, all these species possess similar facies and likenesses in the general appearance of certain structures such as (1) a very high, narrow, and strongly developed metaxyphus in both sexes, (2) large antennae, and (3) the extremity of the last abdominal segment in the male strongly produced downwards on each side in the side in the form of a large toothlike structure (Fig. 11) so as to embrace narrowly the entire apex of the genital operculum. The front femora are without apical tooth or marked sinuosity, and the premedian tooth on inferior edge is fairly large and prominent. The opercula of the females are similar in general appearance and at most only slightly surpass the extremity of the abdomen; the deep thick fringe of stiff, long, reclining, brownish hairs on the underedge of each side of the genital segment is also quite pronounced. As these striking features are shared by a number of American species of the genus *Ranatra*, the structures should be regarded in a general way as "group" characters, which clearly set the members of the *annulipes group* apart from the rest of the species of the genus. Although of similar general appearance, the metaxyphus, anterior femora, and antennae also provide good differential characters of specific importance in this distinctive group of species.

The salient characters by which the species forming the *annulipes group* may be separated from one another include such structures as (1) form and size of body, (2) shape of antennae, (3) shape of anterior femora, (4) size and form of metaxyphus, and (5) shape of male parameres. The illustrations in the text portray the discriminating differences in the antennae, anterior femora, and male parameres of the species.

The species as listed by Kirkaldy (1899, p. 29) from Jamaica and by Hungerford (1936, p. 149) from Yucatán, Mexico, are described herein as new to science. The specimens determined by Montandon (1907, p. 58) as *annulipes* from Colombia, Mexico, and other places represent a composite group of several allied species—all of which are members of the *annulipes* group. The geographics of *R. annulipes* as compiled by Bueno (1906, p. 58) and by Kirkaldy and Bueno (1909, p. 203) represent an aggregate of locality records of several different species. It is thus patent that a large number of the references in the literature to *R. annulipes* refer only in part or not at all to that species, but to complexes of one or more species confused with it, thus invalidating most of the published distributional record for *R. annulipes*.

The tropical and subtropical nature of the members of the *annulipes* group is clearly indicated by the dispersal data of the new and described species. As most of the known records are based largely upon type localities, the species are undoubtedly much more widely dispersed than indicated under the descriptions. Apparently, the *annulipes* group of species occurs only in the Americas.

De Carlo (1950, p. 526) was the first to recognize and separate the true *R. annulipes* Stål of Brazil from its closely related allies. In the foregoing article, he characterized both sexes (female theretofore unknown) and also described a new species of the group from Guayaquil, Ecuador. In his comprehensive work on South American Ranatridae, De Carlo (1946, pp. 14–16) had confused the Ecuadorian species with Stål's *annulipes*. These two papers by De Carlo contain detailed descriptions and many excellent illustrations of the ranatrids of South America.

In order to facilitate future work and to straighten out part of the confusion in the literature, a bibliography is given under the headings of the various species. If a citation includes more than one species, the word *part* is italicized and inserted in parentheses at the end of the reference.

The disposition of the types is given just beneath the description of each new species. Unless stated otherwise, specimens of the described species are in the collections of the authors. The illustrations of *Ranatra annulipes* Stål and *R. zeteki*, n. sp., were made from the types (except *R. fabricii*) by Mrs. Richard Froeschner and the rest by José A. De Carlo.

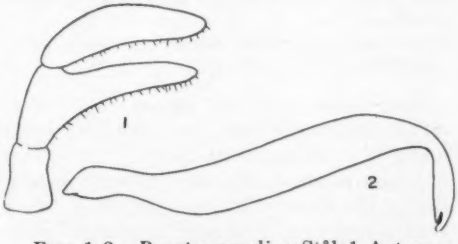
Ranatra annulipes Stål (Figs. 1–2)

1854. *Ranatra annulipes* Stål, Ofv. Vet.-Akad. Forh. **11**: 241.
1861. *Ranatra annulipes* Stål, Ofv. Vet.-Akad. Forh., no. 4: 204.
1905. *Ranatra annulipes* Montandon, Bull. Soc. Sci. Bucharest **14** (3–4): 393–395 (*part*).
1907. *Ranatra annulipes* Montandon, Ann. Soc. Ent. France **76**: 58 (*part*).
1946. *Ranatra annulipes* De Carlo, An. Mus. Arg. Cien. Nat. **42**: 14 (*part*).
1950. *Ranatra annulipes* De Carlo, Rev. Bras. Biol. **10** (4): 526, figs. 14–18.

The following notes are based solely on the male type of *R. annulipes* Stål in the Naturhistoriska Riksmuseum, Stockholm (type kindly lent by Dr. René Malaise).

The type (male) bears labels as follows: (1) "Brasil Oscar", (2) "typus" (red label), (3) "*Ranatra annulipes*" (in Stål's handwriting), and (4) "193" (on a pink label). The specimen, pinned with a large white pin, is in a fair state of preservation. The forelegs are represented by coxae, and the middle and hind legs are entirely wanting. The respiratory appendages are broken (apical part gone) with bases glued on the upper extremity of the last abdominal segment. The hemelytra and wings are partly opened, but otherwise the specimen is in a fairly good state of preservation. The body is in good condition with antennae and parameres fully exposed. Length of male type, 30.00 mm.

Head.—Width across eyes, 3.00 mm. Eyes large, each as wide as interocular space (20:20). Interocular space moderately convex, finely trans-



FIGS. 1, 2.—*Ranatra annulipes* Stål: 1, Antenna; 2, left male paramere.

versely rugulose; jugae long, testaceous, scarcely more elevated than tylus, very feebly bowed outward. Rostrum testaceous with apical segment fuscous. Antennae as in Fig. 1.

Prothorax.—Greatest length (measured on pleuron), 9.60 mm. Pronotum with median length, 8.10 mm; width at apex, 2.25 mm; at narrowest place, 1.22 mm; at widest part of hind lobe (near base), 3.20 mm; front part scarcely more than twice as long as hind part (measured on median line) (56:25). Median part of prosternum between shallow lateral sulci gradually more elevated anteriorly, distinctly tectiform in front. Scutellum with front part a little transversely rugulose, impressed on each side near the middle so as to leave between the two impressions a distinct median carina, pitted in the impressed areas; posterior part slightly convex, without distinct striae. Hemelytra extending on base of genital segment. Abdomen (measured on median line), 18.00 mm long; tergites (save last one) reddish, the connexiva yellowish brown. Parameres as in Fig. 2.

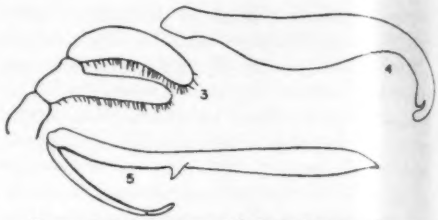
Note.—For a detailed description of both sexes with illustrations of important structures, see De Carlo (1950). It should be noted that the prosternum between the shallow sulci is slowly raised anteriorly and quite tectiform in front. The writers have examined the type and three other specimens of *R. annulipes* from Brasil. The left antenna and left paramere of the type are figured; note especially the shape of the paramere.

Ranatra fabricii Guérin-Méneville (Figs. 3–5)

1857. *Ranatra fabricii* Guérin-Méneville, Sagra's Nat. Hist. Cuba **7** (2): 176.
1908. *Ranatra fabricii* Kirkaldy and Bueno, Proc. Ent. Soc. Washington **10**: 203 (*part*).
1910a. *Ranatra annulipes* Montandon, Ann. Mus. Zool. Della R. Univ. Napoli **3** (n.s.): 3.
1910b. *Ranatra annulipes* Montandon, Bull. Soc. Sci. Bucharest **28** (5–6): 185 (*part*).
1917. *Ranatra annulipes* Van Duzee, Cat. Hemip.: 463 (*part*).
1922. *Ranatra annulipes* Hungerford, Bull. Univ. Kansas **14**: (17): 446 (*part*).

Redescription (male and female).—Body little robust, moderately long, the respiratory tubes usually a little longer than body.

Eyes large, the width of an eye scarcely greater than width of interocular space (20:19). Width of head across eyes, 2.95 mm; interocular space moderately convex, smooth. Antennae as in Fig. 3.



FIGS. 3–5.—*Ranatra fabricii* Guérin-Méneville 3, Antenna; 4, left male paramere; 5, part of foreleg.

Prothorax long, slender, greatest length (measured on pleuron), 10.20 mm. Pronotum with posterior part a little dilated; widest near base, 3.10 mm; width of anterior part at apex, 2.25 mm; median length, 8.80 mm; anterior part scarcely more than twice as long as posterior part (61:29). Scutellum a little convex on anterior part, depressions well marked and separated by a median carina; posterior part with some transverse striae little marked.

Metaxyphus moderately elevated, with inferior surface smooth, feebly convex, broad in front, then slowly narrowed posteriorly and curving upward between the hind coxae. Metaxyphus a little less curved in female. Male parameres as in Fig. 4. Male operculum embraced at apex as in *R. annulipes*. Female operculum pointed at apex, slightly extending beyond extremity of abdomen, the lower edge curving gently upward as it narrows posteriorly.

Anterior legs with coxae 7.00 mm long; femora (fig. 5) 10.80 mm long, moderately large, the inferior edge not very much narrowed in the vicinity of the tooth as may be observed in the illustration. Apex of hind femora not quite attaining the extremity of the hemelytral membrane.

Size.—Length of body of male described, 33.80 mm; respiratory tubes, 34.30 mm; female, 33.00–35.00 mm. long; respiratory filaments, 34.00–36.00 mm.

Distribution.—Known only from Cuba, and widely disseminated on the island. Specimens have been examined from Havana, Nov. 1947, J. Ferrar (figured); Santiago de la Vegas, Havana, Jan. 6, 1940; Santa Clara, May 1911 (Amer. Mus. Nat. Hist.); "Cuba," Uhler Collection, U. S. Nat. Mus.; Matanzas, Feb. 6, 1946, Santiago de las Vegas, May 22, 1933, collected by Mr. Marino.

Affinities.—Distinguished from *R. annulipes* by the form of antennae and male parameres. The metaxyphus is more narrowed posteriorly

and the curvature more pronounced in *R. annulipes*. As *R. fabricii* has been wrongly suppressed as identical with *R. annulipes*, it is here treated as a valid species. The differences between the two species may be noted by the dimensions given in the descriptions and structures figured. *R. sagrai*, n. sp., from Cuba is a larger, stouter species with longer prothorax and fore legs.

Ranatra sagrai, n. sp. (Figs. 6–7)

Female.—Long, robust, the caudal appendages a little longer than the body. Width across eyes, 3.25 mm. Eyes of median size; width of an eye and of interocular space subequal (20.5:21). Interocular space moderately convex, smooth. Antennae as in Fig. 6.

Prothorax long, moderately robust, (measured on pleuron) 11.85 mm long. Pronotum (measured on median line), 10.40 mm long; width at apex, 3.70 mm; width at widest part of base, 3.70 mm; front part practically twice as long as hind part (measured on median line) (69:36). Scutellum about the same as in *R. fabricii*. Female genital operculum scarcely surpassing extremity of abdomen, with inferior edge narrowed and moderately curved upward apically. Metaxyphus moderately elevated, with inferior surface smooth, slightly convex, broad in front and then slowly narrowed posteriorly, curving very little in the middle posteriorly.

Anterior coxae 8.00 mm long, without markings; femur (Fig. 7) 12.00 mm in length, robust, the inferior edge in the region of the tooth very little narrowed; tooth placed as in *R. fabricii*. Apex of hind femora not reaching to the extremity of the membrane.

Size.—Length of female, 38.00 mm; respiratory appendages, 42.00 mm.

Type (male).—Santiago de las Vegas, Cuba, collected by S. C. Bruner, in collection of C. J. Drake. Named in honor of Ramon de la Sagra, the author of *Historia Fisica, Politica Natural de la Isle de Cuba*.

Affinities.—Differs especially from *R. annulipes* by the form of the metaxyphus; from *R. fabricii* by its larger body, longer caudal filaments, longer anterior coxae and form of metaxyphus.

Ranatra zeteki, n. sp. (Figs. 8–11)

1905. *Ranatra annulipes* Montandon, Bull. Soc. Sci. Bucharest **18** (2–4):394 (*part*; specimen from Panama).

1907. *Ranatra annulipes* Montandon, Ann. Soc. Ent. France **76**: 58 (*part;* specimens from Panama and Colombia).

Moderately long, moderately slender, respiratory appendages a little longer than the body. General color yellowish brown with legs banded or mottled with testaceous. Female usually longer than the male, also with longer respiratory filaments.

Size.—Length of body (male), 29.00–32.00 mm, the respiratory tubes, 31.00–34.50 mm; (female) length, 30.00–34.60 mm, the respiratory tubes, 35.00–40.00 mm.

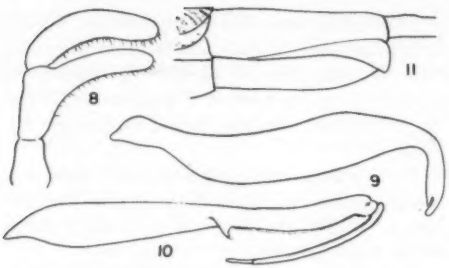
Eyes large, the width of an eye and width of interocular space nearly equal (19:18, male; and 21:22, female). Interocular space moderately convex, smooth; jugae prominent, a little more elevated than tylus, testaceous. Width of head across eyes, 2.80 mm in male and 3.25 mm in female. Antennae as in Fig. 8.

Pronotum long, rather slender, the front part more than twice as long as hind part (52:27); length on median line, 8.10 mm in male and 9.00 mm in female; width of hind lobe near base, 2.25 mm in male and 3.25 mm in female; width at anterior end of front lobe, 2.05 mm in male and 2.35 mm in female; hind lobe not greatly widened in either sex, deeply roundly excavated behind. Prothorax (measured on pleuron) 9.00 mm long in male and 10.16 mm in female. Scutellum with anterior part feebly convex, smooth, indistinctly rugulose, strongly impressed on each side just in front of middle, there with a thick median carina separating the two impressions; hind part triangular, strongly narrowed posteriorly, without transverse striae.

Metaxyphus high, wide in front, becoming strongly narrowed posteriorly, turning abruptly upward a little before hind margins of metacoxae. Male operculum (Fig. 11) embraced at apex as in *R. annulipes*. Male parameres as in Fig. 9. Apex of female operculum feebly surpassing last abdominal segment.

Legs long and slender, coxae and femora with pale testaceous spots or marks. Fore femora (Fig. 10) not very much narrowed on inferior edge in vicinity of the premedian tooth; length of male, 9.50 mm and female, 13.30 mm; length

FIGS. 6, 7.—*Ranatra sagrai*, n. sp.: 6, Antenna; 7, part of foreleg.



FIGS. 8–11.—*Ranatra zeteki*, n. sp.: 8, Antenna; 9, left male paramere; 10, part of foreleg; 11, apex of male abdomen.

of fore coxae, 6.00 mm in male and 7.60 mm in female. Hind femora barely reaching base of genital segment; length, 13.40 mm in male and 18.60 mm in female. Length of female operculum, 3.10 mm. Length of abdomen, 16.80 mm in male and 18.75 mm in female. Middle and hind legs with broad testaceous bands.

Type (male) and *allotype* (female).—Panama, Canal Zone, Feb. 10–12, 1939, in Drake Collection. Paratypes, 32 specimens, taken with type in sluggish, salty waters, near the mouth of small streams emptying in to the sea or Panama Canal, and also in deep stagnant water of a narrow drainage ditch (all by C. J. Drake). One paratype, Panama, Canal Zone, April 14, 1911, E. A. Schwartz, U. S. Nat. Mus. Several other specimens have also been examined from Colombia and Venezuela. Paratypes in collections of both authors.

Affinities.—Separated from *R. annulipes* by the shape of the metaxyphus and male parameres. The eyes are also feebly wider than the width of interocular space.

Ranatra acapulcana, n. sp. (Figs. 12–14)

Male and female.—Long, slender, female a little stouter and longer than the male; respiratory filaments a little longer than the body in both sexes. Width of head across eyes, 2.80 mm (male) and 3.00 mm (female); width of an eye slightly greater than width of interocular space (19:18 in male and 20.5:19 female). Interocular space smooth, a little convex; jugae slightly more elevated than tylus. Antennae as in Fig. 12.

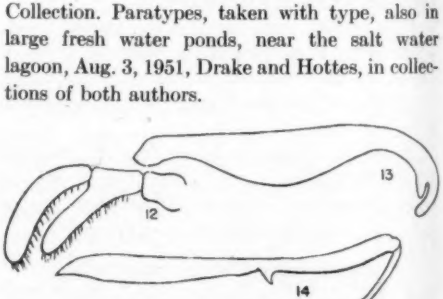
Prothorax long and slender, greatest length (measured on pleuron), 9.20 mm in male and 10.15 mm in female. Pronotum not much dilated behind; greatest width of hind part (near base), 2.80 mm in male and 3.25 mm in female; median length, 7.80 mm in male and 9.70 mm in female; anterior part slightly more than twice as long as hind part (55:23 in male and 67:30 in female); width at apex, 1.90 mm in male and 2.15 mm in female. Scutellum a little convex in the middle of anterior part, depression well marked and separated by a thick median carina, which is as long as the depressions; posterior part without transverse striae.

Male parameres as in Fig. 13. Male genital operculum enveloped at apex as in *R. annulipes.* Female genital operculum narrowed (slightly rounded) from near the base apically, the pointed apex scarcely surpassing extremity of the abdomen. Metaxyphus moderately elevated, a little convex at the middle, with inferior surface smooth, broad at the base, then narrowed posteriorly, ending behind in a pronounced curve between the hind coxae but not as vertical as in *R. annulipes.*

Anterior femora (Fig. 14) 10.00 mm long in male and 11.50 mm in female, a little narrowed on inferior edge in the vicinity of the tooth, the tooth placed as in *R. fabricii*; anterior coxae 6.60 mm long in male and 7.60 mm long in female, the exterior surface with pronounced pale and obscure fuscous markings. Hind femora marked with fuscous-brown spots, the apex reaching the extremity of the hemelytral membrane.

Size.—Length of male, 28.60–30.00 mm, and female, 36.00–39.00 mm; respiratory appendages, 29.00–32.00 mm in male and 36.00–39.00 mm in female.

Holotype (male) and *allotype* (female).—Taken in a large salt water lagoon, near Acapulco, Mexico, July 23, 1950 (C. J. Drake), in Drake Collection. Paratypes, taken with type, also in large fresh water ponds, near the salt water lagoon, Aug. 3, 1951, Drake and Hottes, in collections of both authors.



FIGS. 12–14.—*Ranatra acapulcana*, n. sp.: 12, Antenna; 13, left male paramere; 14, part of foreleg.

Affinities.—Differentiated from *R. annulipes* by the shape of male parameres, antennae and metaxyphus, also by the pale and obscure fuscous markings on femora and tibiae. *R. zeteki*, n. sp., has differently shaped male parameres. The metaxyphus also separates it from other members of the *annulipes* group.

Ranatra jamaicana, n. sp. (Figs. 15–17)

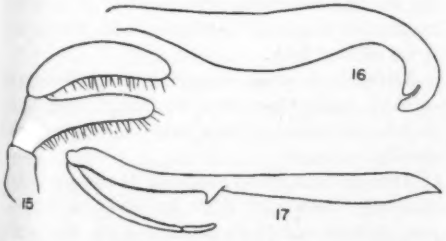
1899. *Ranatra annulipes* Kirkaldy, Entomologist **32**: 29.
1903. *Ranatra annulipes* Montandon, Bull. Soc. Sci. Bucharest **14** (3–4): 393–394 (*part*).

Male.—Body long, a little robust, the caudal appendages a little longer than the body. Width of head across eyes, 2.85 mm. Eyes of median size, width of an eye less than width of interocular space (18.5:20). Interocular space moderately convex, smooth; jugae distinctly more raised than tylus. Antennae as in Fig. 15.

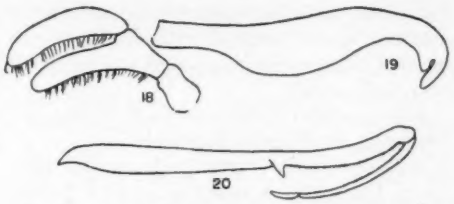
Prothorax moderately long; greatest length (measured on pleuron), 9.20 mm. Pronotum slender, anterior part slightly more than twice as long as posterior part (58:27); width at anterior end, 2.20 mm; width at widest place in hind part (near base), 3.00 mm. Scutellum as in *R. fabricii*. Metasternum with the longitudinal pale stripes a little obscure, the lateral ones extending on metacoxae and median on metaxyphus.

Male parameres as in Fig. 16. Male genital operculum enveloped at the extremity as in *R. annulipes*. Metaxyphus broad in front, rather slowly narrowed posteriorly to curvature, then strongly narrowed as it turns up between metacoxae.

Anterior femora (Fig. 17) 10.30 mm long, moderately thick, broad, with inferior edge in vicinity of tooth very little narrowed, the tooth situated as in *R. fabricii*. Marks on coxae and pale bands on middle and hind femora as in *R. fabricii*.



FIGS. 15–17.—*Ranatra jamaicana*, n. sp.: 15, Antenna; 16, left male paramere; 17, part of foreleg.



FIGS. 18–20.—*Ranatra absona*, n. sp.: 18, Antenna; 19, left male paramere; 20, part of foreleg.

Size.—Length of body, 31.00 mm; respiratory tubes, 31.00 mm.

Holotype male.—St. Andrews, Constant Springs, Jamaica, C. P. Taylor, in collection of C. J. Drake.

Affinities.—Differs from *R. annulipes* in the form of male parameres, smaller eyes, antennae and characteristics of the metaxyphus. These same structures also separate it from *R. absona*, n. sp. The type bears a label in Montandon's handwriting, which states that the specimen conforms with the type except that the obscure bands on the sternum are less indicated.

Ranatra absona, n. sp. (Figs. 18–20)

Male.—Body a little robust, the caudal appendages a little longer than the body. Width across eyes, 3.00 mm. Eyes large, the width of an eye slightly greater than width of interocular space (20.5:19). Interocular space moderately convex, smooth. Antennae as in figure 18.

Prothorax long and slender; greatest length (measured on side), 9.70 mm. Pronotum a little dilated behind; width of anterior part at apex, 2.10 mm; width at widest point of posterior part (near base), 2.80 mm; length on median line, 8.40 mm; front part a little more than twice as long as hind part (60:24). Scutellum practically the same as in *R. fabricii*. Mesosternum with the longitudinal stripes a little obscure, not extending posteriorly on metaxyphus.

Male parameres as in Figure 19. Apex of male operculum embraced as in *R. annulipes*. Metaxyphus moderately elevated, with inferior surface smooth, slightly convex, broad in front, then narrowed posteriorly, very little convex at the middle, terminating in an almost vertical curve between the metacoxae.

Anterior femora as in Fig. 20, rather thick medianly, with inferior edge bearing the tooth very little narrowed at the middle; 10.50 mm long; tooth situated as in *R. fabricii*; length of

fore coxae, 6.60 mm. Apex of hind femora not attaining tip of hemelytral membrane. Intermediate and posterior femora with pale bands not very well marked.

Size.—Length of body of male, 32.00 mm; respiratory appendages, 33.50 mm.

Holotype (male).—Pinto Gordo, British Honduras, Feb. 1932, in collection of C. J. Drake, paratypes, 2 specimens, taken with type, one in collection of each author.

Affinities.—Differs especially from *R. annulipes* in the form of the male parameres, anterior femora and antennae; these structures also separate it from *R. fabricii*. The metaxyphus is more elevated, more curved and narrowed on posterior part than in *fabricii*. Also, the metaxyphus is broader on the anterior three-fourths of inferior surface than in *R. annulipes*.

Ranatra similis, n. sp. (Figs. 21–23)

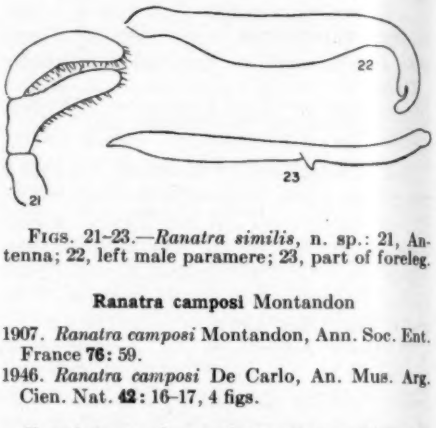
Male.—Long, body little robust, the caudal appendages a little longer than the body. Width of head across eyes, 3.00 mm. Eyes of median size; width of an eye slightly shorter than the shortest distance between them (21.5:19). Interocular space moderately convex, with fine transverse striae. Antennae as in Fig. 21.

Prothorax moderately long, slender, greatest length (measured on pleuron), 9.80 mm. Pronotum widened a little behind, the front part scarcely more than twice as long as hind part (57:28); length on median line, 8.50 mm; greatest width of hind part, 3.40 mm; width at apex of front part, 2.35 mm. Scutellum very similar to *R. fabricii*.

Metaxyphus moderately elevated, with inferior face slightly convex, a little widened in front, moderately narrowed from middle posteriorly, forming a pronounced curve behind. Apex of male operculum enveloped as in *R. annulipes*. Male parameres as in Fig. 22. Anterior legs with femora (Fig. 23) moderately broad, 11.00 mm long, with lower edge very little narrowed in vicinity of the tooth, which is placed as in *R. fabricii*. Apex of hind femora not quite reaching extremity of hemelytral membrane.

Type (male).—Satipo, Peru, July, 1940, collected by Pedro Paprachki, in collection of C. J. Drake.

Affinities.—Distinguished from *R. annulipes* by the form of the parameres, antennae and metaxyphus; from *R. jamaicana*, n. sp., by the same characters and besides there are no clear or obscure bands on the mesosternum. The metaxyphus in *R. similis* is narrowed posteriorly in its greatest part and then turns up more progressively between metacoxae. In *R. absona*, n. sp., and *R. annulipes* the metaxyphus turns up almost vertically between hind coxae.



FIGS. 21–23.—*Ranatra similis*, n. sp.: 21, Antenna; 22, left male paramere; 23, part of foreleg.

Ranatra camposi Montandon

1907. *Ranatra camposi* Montandon, Ann. Soc. Ent. France **76:** 59.
1946. *Ranatra camposi* De Carlo, An. Mus. Arg. Cien. Nat. **42:** 16–17, 4 figs.

Female larger than male; respiratory filaments generally a little longer than the body, sometimes slightly shorter. Eyes large; width of an eye slightly greater than width of interocular space (20:19) interocular space moderately convex, smooth; jugae prominent. Antennae as in figure 24.

Prothorax moderately long, greatest length (measured on pleuron) 7.80 mm in male and 8.80 in female. Pronotum a little dilated behind, length (measured on median line) 6.90 mm in male and 7.80 mm in female; width at apex of anterior part 2.00 mm in male and 2.25 mm in female; width at widest point of hind part 2.70 mm in male and 3.10 mm in female.

Scutellum very little convex, with some transverse rugulae in front, with a thick carina separating the impressed areas just in front of tapering hind part; triangular hind part with transverse striae well marked.

Metaxyphus large, characters about the same as in *R. acapulcana*. Apex of female operculum slightly extending beyond extremity of last abdominal segment.

Anterior femora robust, with the upper edge near the tooth very little narrowed, 8.00 mm long in male and 10.20 mm in female, the tooth placed as in *R. fabricii*. Tip of hind femora barely reaching apex of hemelytral membrane.

Size.—Length, 25.80–27.40 mm (male) and 28.00–31.00 mm (female); respiratory appendages, 25.50–29.00 mm (male) and 26.85–3.20 mm (female). In most of our specimens the caudal filaments are slightly longer than the body. Montandon (1907) gives their length in the type as slightly shorter than the body.

Distribution.—The writers have examined more than 60 nymphs and adults from Guayaquil, Ecuador, all collected by Dr. Francisco Campos R. The types were also taken at Guayaquil by Dr. Campos.

Affinities.—The size of body, metaxyphus and male parameres separate *R. camposi* from *R. annulipes*. The smaller form, shorter caudal appendages and shorter fore legs separate it from *R. ecuadoriensis* De Carlo.

Ranatra ecuadoriensis De Carlo

1946. *Ranatra annulipes* De Carlo, An. Mus. Arg. Cien. Nat. **42**: 14–16, 3 figs. (*part*).

1950. *Ranatra ecuadoriensis* De Carlo, Rev. Bras. Biol. **10** (4): 525–526, figs. 9–10.

For a detailed description and illustrations of this species, see De Carlo's paper of 1950. The male is unknown. The following notes are based upon three females, Guayaquil, Ecuador, Jan. 26, 1952, taken in a temporary rainwater pool, Dr. F. Campos, in company with numerous specimens of *R. camposi* Kirkaldy.

General aspect very similar to *R. camposi*, larger and with the anterior femora and prothorax longer. Length of body, 32.50 mm; respiratory tubes, 34.50 mm; anterior femora, 10.30 mm; coxae, 7.10 mm; pronotum on median line, 8.80 mm. Antennae and anterior femora as figured by De Carlo (1950).

Affinities.—This species is most closely related to *R. camposi*, but is readily separated from it by the dimensions of the body, anterior legs, and respiratory appendages.

ENTOMOLOGY.—*An interesting new pyrgomorphine grasshopper (Orthoptera: Acrididae) in the U. S. National Museum.* D. KEITH MCE. KEVAN, University of Nottingham. (Communicated by Ashley B. Gurney.)

In the course of an examination of acridid material of the sub-family Pyrgomorphinae kindly lent to me for study by the Smithsonian Institution, I came across an interesting new species of *Chlorizeina* Brunner von Wattenwyl, 1893. Unfortunately it is known only from a few specimens but, since they considerably extend the known range of the genus, I do not think it inadvisable to describe it.

Chlorizeina malabarensis, n. sp.

TYPE: ♂, India, Mangalore, June [1925], J. C. Bridwell. U. S. National Museum No. 61121.

Head.—Antennae longer than head and pronotum together, filiform, the basal half slightly flattened. Eyes prominent, oval, a little longer than wide. Frons slightly rugose, strongly oblique, concave in profile. Frontal ridge strong, narrow, deeply sulcate throughout, not reaching the clypeus. Lateral carinae strong, almost straight and only slightly divergent. Cheeks with minute scattered punctures and with a partial oblique row of small, weak, rounded tubercles extending from behind the eye to the anterolateral angle of the pronotum. Fastigium verticis rugoso-punctate, longer than wide, rounded apically (Fig. 1, A). Median carinula of head faint but distinct throughout. Dorsal surface of head finely punctured all over, with fine transverse rugae in the vicinity of the median carinula, especially in front of the eyes.

Thorax.—Pronotum subcylindrical, strongly but finely punctured throughout, less so in the posterior part of the metazona; anterior margin slightly concave; posterior margin almost straight; median carina obsolescent; lateral carinae absent; transverse sulci fine, more or less straight, the median one placed at about the middle of the disc, the typical one at rather less than three-quarters (Fig. 1, A), anterior sulcus obsolescent, almost invisible; lateral pronotal lobes with anterior angle rounded, posterior angle forming a right-angle and inferior margin slightly sinuous. Mesonotum for the greater part concealed. Metanotum about equal to the metazona of the pronotum. Prosternal tubercle situated rather far forward, pyramidal, very slightly inclined backwards, very strongly acute. Mesosternal lobes about one and a half times as long as wide, their interspace of about the same dimensions as a lobe. Metasternal pits fairly large,

deep, and separated by a distance equal to about one-third of the greatest width of a metasternal lobe.

Wings.—Tegmina abbreviate, almost reaching the posterior margin of the first abdominal tergum, ovate-lanceolate, about twice as long as wide, acutely pointed (Fig. 1, A), veins indistinct, costal margin slightly convex, anal margin strongly so and distinctly punctured. Hind wings minute, scale-like.

Genitalia.—Tenth abdominal tergum excised and carinate as illustrated (Fig. 1, B). Epiproct flat, tonguelike (Fig. 1, B). Cerci long, strongly inwardly and upwardly curved, extending to about the end of the epiproct, narrowed before the middle and slightly thickened apically (Fig. 1, B, C). Subgenital plate obtuse.

Measurements.—Length 38; antenna 16.5; head 7.0; pronotum 7.5; tegmen 6.5; hind femur 20.5 mm.

Coloration.—More or less uniform olive-green [somewhat discoloured] except for the dark brown antennae, brown eyes, dark green gular area above the diagonal row of yellowish cheek tubercles, and the pink inferoexternal area of the hind femur.

ALLOTYPE: ♀, India, Goa, Mormugao, Sept. 1925, J. C. Bridwell.

Agrees with the type but is larger with a less cylindrical pronotum which is considerably wider behind than in front; the mesosternal lobes are scarcely longer than wide and their interspace is greater than the width of a lobe; metasternal pits separated by a distance equal to more than half a metasternal lobe. The tenth abdominal tergum is excised to the posterior margin of the ninth, the epiproct is broader than in the male and the cerci are short, straight and stout, about half as long as the epiproct. The ovipositor valves are short and stout.

Measurements.—Length 45; antenna 16.0; head 7.0; pronotum 9.5; tegmen 7.0; hind femur 20.5 mm.

PARATYPE: ♂, Same data as the allotype (British Museum).

Agrees with the type but is a little smaller and paler.

This new species is much larger than any of the three previously described. In build it resembles more closely *C. unicolor* Brunner von Wattenwyl, 1893 (*cf.* Ramme, 1941, pl. 12, figs. 1a, 1b, 2), but the genitalia are more like those of *C. ele-*

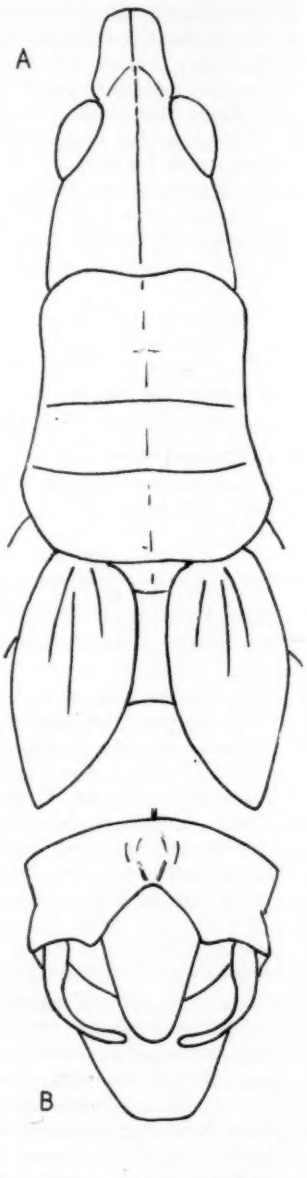


FIG. 1.—*Chlorizeina malabarensis*, n.sp.: A, Head and thorax of male (type), dorsal; B, male genitalia, dorsal; C, male cercus, lateral.

gans Ramme, 1941 (*cf.* Ramme, *l.c.*: 36, Abb. 13), although the cerci are distinctly more strongly curved.

A third species, *C. togulata* Rehn (1951), described from the Southern Shan States, Burma, has much broader cerci than those of *malabarensis*.

The genus was previously known only from Burma, and it is interesting to find that its range extends to the west coast of India. *C. elegans* is known from Upper Burma; *C. unicolor* was previously known only from Lower Burma but is now known to me from Upper Burma also.

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REHN, J. A. G. *A new species of the genus* Chlorizeina (*Acrididae*; *Pyrgomorphinae*) from Burma. Notulae Nat., no. 238: 1–7, 6 figs. 1951.

ENTOMOLOGY.—*On a collection of* Phlebotomus *from the Yemen.*

OSKAR THEODOR, Department of Parasitology, Hebrew University, Jerusalem. (Communicated by C. W. Sabrosky.)

The collection dealt with in the present note was made by Lt. Comdr. K. L. Knight, of the U. S. Naval Research Medical Unit No. 3, Cairo, Egypt, in January 1951 in southern Yemen. Practically nothing is known of the sandfly fauna of Arabia and these records may be considered as new. The collections made by Commander Knight are as follows:

Coll. 304. Ta'izz, Yemen. Jan. 12, 1951. Elev. 4,100 feet. Trapped on oiled paper at base of stone walls at damp spots by cess-pit drainages, in the city proper. *P. sergenti*, *P. langeroni* var. *orientalis*, *P. chinensis arabicus*, n. subsp., *S. tiberiadis*.

Coll. 306. Ta'izz, Yemen, Jan. 14, 1951. Elev. 3,590 feet. Trapped on oiled paper at entrances of rodent burrows (mostly *Arvicanthus* sp.) on an aloe-euphorbia hillside. Outside the town about 3 miles. *P. papatasii* var. *bergeroti*, *P. roubaudi*, *P. langeroni* var. *orientalis*, *S. africana*, *S. schwetzi*, *S. antennata* var. *cincta*.

Coll. 307. Ta'izz, Jan. 15, 1951. Same as coll. 304. Same species.

Coll. 309. El-Hauban, Wadi el-Maleh, about 3 miles east of Ta'izz. Jan. 17, 1951. Elev. about 3,700 feet. Trapped on oiled paper in rodent burrows at base of small rock cliff. *P. roubaudi*, *S. tiberiadis*.

Coll. 15. Ta'iz, Yemen. Jan. 21, 1951. Caught biting a number of small boys sitting near our quarters in town. From dark until 19:45 hours. Bright moon. *P. papatasii* var. *bergeroti*, *P. sergenti*, *P. langeroni* var. *orientalis*, *P. chinensis arabicus* n. subsp.

Genus **Phlebotomus** Rondani, 1840

Subgenus **Phlebotomus** Rondani

Phlebotomus papatasii var. **bergeroti** Parrot, 1934

3 ♂♂, 1 ♀ coll. 306; 1 ♀ coll. 15, biting man in Ta'izz. The species has been recorded from Djanet in southern Algeria, from Abyssinia, and the Anglo-Egyptian Sudan.

Phlebotomus roubaudi Newstead, 1913

1 ♀, 5 ♂ ♂ coll. 306; and 1 ♀ coll. 309 from rodent burrows.

This species was originally described from Akjoucht in Mauretania and has subsequently been found to occur in a belt south of the Sahara throughout Africa. It has been found by Kirk and Lewis west of Lake Rudolf in the Anglo-Egyptian Sudan.

The absence of typical *P. papatasii*, which is closely related to these two species and which occurs commonly in the Anglo-Egyptian Sudan (together with *P. papatasii* var. *bergeroti* but not with *P. roubaudi*) is noteworthy.

Subgenus **Paraphlebotomus** Theodor, 1948

Phlebotomus sergenti Parrot, 1917

2 ♂♂, 2 ♀ ♀ coll. 304/307; 1 ♀. coll. 15, biting man in Ta'izz. This species is known from the central Sahara, French West Africa, the southern Mediterranean, and from the Middle East, extending into North West India. It is very common in Bagdad, where it is the main carrier of Oriental sore and rare in Palestine. It has not been recorded from the Anglo-Egyptian Sudan or from Abyssinia, where 2 other species of the subgenus occur (*P. alexandri* and *P.*

sergenti var. *saevus*). It may therefore be assumed that *P. sergenti* reached Arabia from the north.

Subgenus **Laroussius** Nitzulescu, 1931

Phlebotomus langeroni var. **orientalis** Parrot, 1936

38 ♀♀ coll. 15, biting man in Ta'izz; 5 ♂♂ coll. 304/307; 12 ♂♂ coll. 306 from rodent burrows.

This is the most numerous species in the collection. It was raised to specific rank by Parrot in 1946, but the differences from *P. langeroni* are so small that it is probably better regarded a variety or subspecies of *P. langeroni*. *P. langeroni* var. *orientalis* is known from Abyssinia and from the Anglo-Egyptian Sudan, mainly in the area west of Lake Tana. It is the only common representative in the area of the subgenus *Laroussius* (major group), which contains the principal carriers of Kala Azar in the Mediterranean, and it is considered the carrier of Kala Azar in the Sudan. *P. longipes*, which also belongs to this subgenus, has, according to Kirk and Lewis, been found only in one locality in the Sudan, from which Kala Azar is not known.

A few cases of Kala Azar have been recorded from Arabia. Two cases were recorded by Phillips (1904) in adults of 30 and 35 years of age from the Yemen and the Hedjaz. Whittingham (1937) mentions the case of a British officer who contracted the disease in Aden. Two further cases were recently recorded by Fawdry and Mazhar (1951) in children of 4 and 6 years, one from Ta'izz and the other from Beidha, 150 miles north of Aden. Two cases were recently diagnosed in Jerusalem in immigrants (young adult males) from the Yemen (unpublished). According to the age distribution of the few cases known from Arabia, the disease seems to be of the Sudanese type of Kala Azar, which according to Kirk "is chiefly a disease of late childhood and early adult life" and not as Mediterranean Kala Azar mainly a disease of young infants. Whittingham mentions that the sandflies from Aden were repeatedly identified as *P. perniciosus*. This species, which occurs only in the western Mediterranean, was not then distinguished from *P. langeroni* and its related forms. Presumably the sandflies from Aden were also *P. langeroni* var. *orientalis*. This species is thus apparently common in southern Arabia and bites man as the present records show. *P. langeroni* var. *orientalis* may therefore be considered also as the carrier of Kala Azar in southern Arabia.

Subgenus **Adlerius** Nitzulescu, 1931

Phlebotomus chinensis arabicus, n. subsp

1 ♂, 1 ♀ coll. 304/307; 1 ♀. coll. 15, Ta'izz, biting man.

The occurrence of a form of *P. chinensis* in southern Arabia is very interesting. The species consists of 6 or 7 local forms, which are widely distributed throughout Asia, including northern India and China, the Middle East, and the eastern Mediterranean. None has been recorded so far from the Ethiopian region or North Africa. The various forms differ in the male mainly in the shape of the penis and the length of the genital filaments and in the armature of the pharynx in the female and in various measurements. The status of these forms has not yet been finally determined and a study of the whole group is required. They will probably have to be made into subspecies or even species.

Female.—Size 2.5 to 3 mm. Wing, length 2.5 to 2.9 mm; width 0.6 to 0.8 mm. Wing index α/β = 1.8 to 2.3 mm. Palp formula: 1, 4 (2, 3), 5. Relative length of segments: 1-4-4-3.4-8. Antennae: Segment 3 > 4 + 5. A3/E = 1. Armature of pharynx rather similar to that of *P. chinensis* var. *simici*, extending forward about a quarter of the length of the pharynx. Spermatheca as in the other forms of *P. chinensis*.

Male.—Size 2.5 mm. Wing, length 2.5 mm; width 0.65 mm. Wing index α/β = 1.7. Palp formula 1, 4, 2, 3, 5, . Relative length of segments: 1-3.3-3.8-3-9. Antennae: Segment 3 > 4 + 5. A3/E = 1.5.

Genital filaments eight times as long as pump. Penis with a very shallow subterminal tubercle, which is rather far removed from the tip.

The subspecies from the Yemen resembles most closely the form from Cyprus but differs in the antennal index A3/E, which is 0.7 in the ♀ and 1.1 in the ♂ in the Cyprus form. The genital filaments are longer (6.6 times as long as the pump in the Cyprus form) and the subterminal tubercle is shallower and further removed from the tip than in the Cyprus form.

Type at present in the author's collection.

Genus **Sergentomyia** Franca, 1920

Subgenus **Sergentomyia** Franca

Group fallax

Sergentomyia antennata var. **cincta** Parrot and Martin, 1944

3 ♀♀, 4 ♂♂ coll. 306, from rodent burrows. The species occurs in the Anglo-Egyptian Su-

dan, French Somaliland, and Uganda. It has 14 to 20 teeth in the buccal cavity and a rather narrow pharynx with relatively coarse teeth in the female. The specimens from the Yemen agree well with the description of the species. There are about 20 teeth in the buccal cavity of the female.

Sergentomyia schwetzi Adler, Theodor, and Parrot, 1929

2 ♀ ♀, 1 ♂ coll. 306, from rodent burrows.

Group africana

Sergentomyia africana Newstead, 1912

3 ♀ ♀ coll. 306, from rodent burrows.

Kirk and Lewis (1951) propose to change the name of the species to *S. freetownensis*. This change, however, requires a ruling of the International Commission for Zoological Nomenclature, suppressing the name *S. africana*. The old name is therefore retained until the nomenclatorial position is clarified.

Subgenus **Sintonius** Nitzulescu, 1931

Sergentomyia tiberiadis Adler and Theodor, 1930

Syn. **S. subtilis** Parrot and Martin, 1944

6 ♂ ♂, 1 ♀ Ta'izz, coll. 304/307; 1 ♂ coll. 309, El-Hauban.

The species was recorded from Abyssinia by Parrot in 1936 as *P. tiberiadis*. Later Parrot described the male of the species as *P. subtilis*, and in 1940 Parrot redescribed both sexes under the name *P. subtilis*. Comparison of the type specimens of *P. tiberiadis* from Palestine with specimens of Parrot's original series, with specimens from the Sudan, and with the specimens from the Yemen showed that there are practically no constant differences between the material from the different localities. The characters on the basis of which Parrot separated *S. subtilis* from *S. tiberiadis* are so small and variable that they do not justify the retention of *S. subtilis* as a separate species.

The *Phlebotomus* fauna of the Yemen is thus, as was to be expected, mainly Ethiopian in character. Seven out of the 9 species recorded occur in Abyssinia and the Anglo-Egyptian Sudan. Only one Mediterranean species, *P. sergenti*, and a new subspecies of *P. chinensis* were found, the various forms of which are widely distributed in Asia and the eastern Mediterranean.

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BIOLOGY.—*New records of* Diaptomus sanguineus *and allied species from Louisiana, with the description of a new species* (*Crustacea: Copepoda*).

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Marsh's record of the occurrence in Louisiana of the fresh-water copepod *Diaptomus sanguineus* Forbes appears to be based upon personal correspondence with Edward Foster (see Marsh, 1929, pp. 13, 15, and 17), whose manuscript records were published by Penn (1947). This lists the species as occurring near Slidell, in St. Tammany Parish, rather than near New Orleans as given by Marsh. Collections made in 1951 and 1952 by one of us (Moore) indicate that the species is very common in St. Tammany Parish, where it occurs in seasonal ponds and ditches, frequently in association with *Diaptomus stagnalis* and *D. conipedatus*. Collections made near Alton and Florenville from January to February 29 contained adults; most females collected on the latter date were ovigerous. The species also has been found in temporary pools and ponds north of Alexandria, Rapides Parish, in the central part of the State. Here most of the specimens found on December 28 were immature; only adults were present in collections made on April 6.

Two species allied to *sanguineus* have

been found in our Louisiana collections. The little-known *Diaptomus virginiensis* and a new species are described below from specimens collected in St. Landry and Evangeline Parishes.

Diaptomus (Onychodiaptomus) virginiensis Marsh

Figs. 11–12; 21–25

Diaptomus virginiensis Marsh, 1915, p. 457, figs. 1–5; 1929, p. 23.

Specimens examined.—Type lot: from Marsh collection in U. S. National Museum, Marsh nos. 4064, 4067, 4154. Great Falls, Va.

Louisiana: 20 ♀ (4 ovigerous), 1 ♂, ditch pond on U. S. Highway 71, south of Lebeau, St. Landry Parish, April 5, 1951, W. G. Moore; 6 ♀, same location (ditch ponds on opposite sides of highway—4 ♀ in one, 2 ♀ in other), December 27, 1951, W. G. Moore.

The only record of this species in literature is that of the type locality in Virginia. The Louisiana specimens agree very closely with the type material examined, so that there is no doubt of the identity of the species.

The Louisiana specimens are a little larger than those recorded by Marsh: ♀, 1.41–1.61 mm, ♂, 1.3 mm. (Marsh's figures are: ♀, 1.366, ♂, 1.24 mm).

The illustrations given here are all drawn from the Louisiana specimens. There are no differences between the fifth leg of the Louisiana male and the type specimens from Virginia. Such differences as appear when Fig. 22 is compared with Marsh's description and illustration (Marsh, 1915, fig. 5) have not been found to exist in the types. These include the greater length of the spine of the right basipod segment 1, the presence of the small sclerotized lamella of the distal outer portion of basipod 2, the presence of the prominent double-lined ridge of the second exopod segment, and the greater length of the lateral spine, which is placed at the middle of the segment and reaches to or beyond its apex.

The proximal pad of the apical segment of the left exopod does not occupy half of the inner margin as stated by Marsh; he must have included a portion of the distal pad which covers most of the posterior face. The inner process arises near the distal part of this pad (Fig. 23) and forms a pincer with the distal process, as in *sanguineus*. The distal process is stout and digitiform, its length a little less than one-half that of the outer margin of the segment (7:16).

Marsh has not described the urosome of the male, which is moderately asymmetrical. Groups of minute spinules such as those found on the dorsal face of the fourth segment in the Louisiana specimen (Fig. 21) are also present in the type material. These have not been found in any other species of the group.

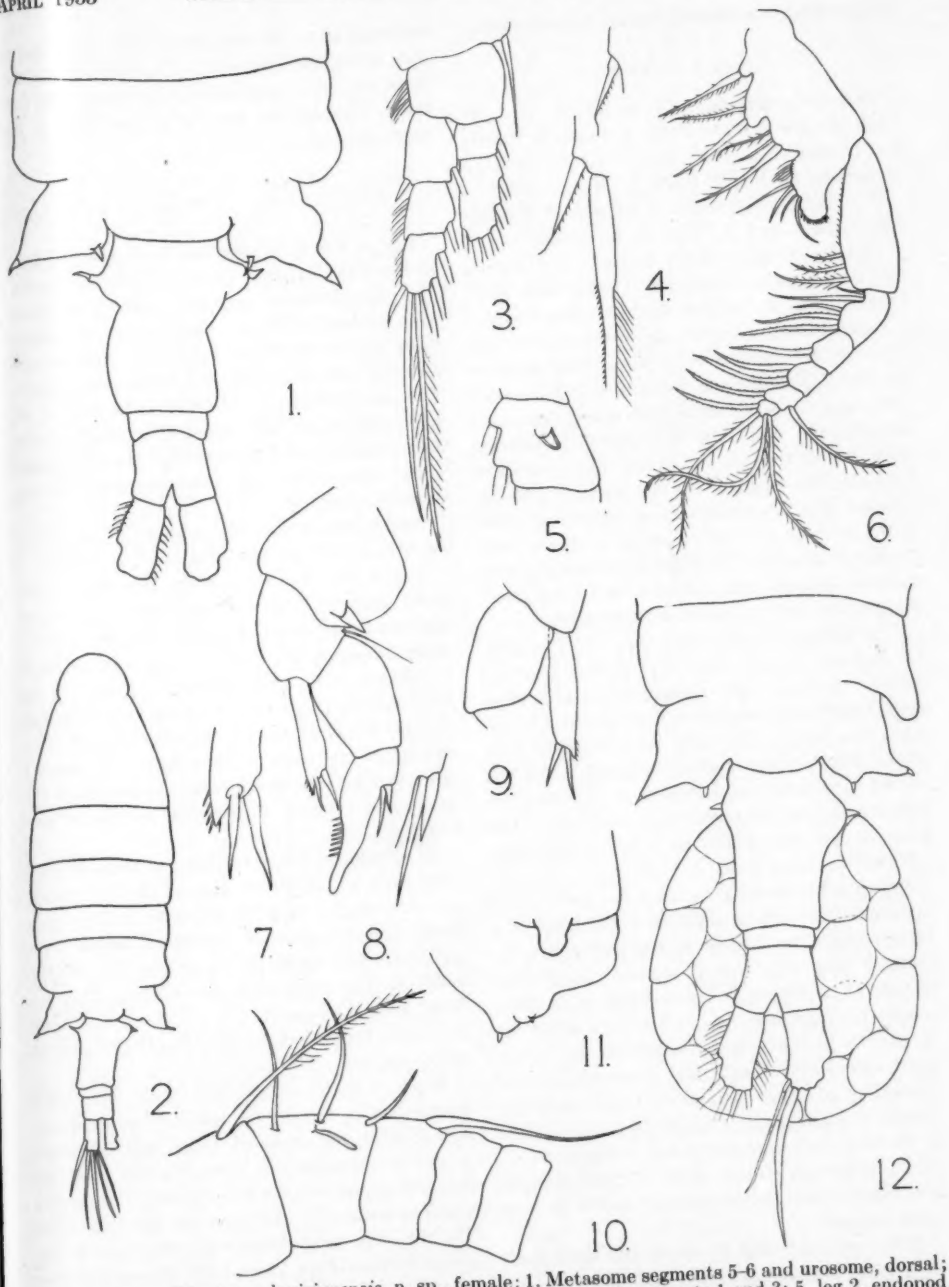
The important characters of the right antennule of the male have not been described. The Louisiana specimen agrees exactly with those of the type lot. The relative development of the spines of segments 10, 11, and 13 are unusual in North American diaptomids (Fig. 25). Those of 10 and 11 are very short, being only a little longer and stouter than the minute spines of segments 8 and 12. That of segment 13 is excessively large, reaching to about the middle of segment 15. The relative lengths of the spines are:

Segment	8	10	11	12	13
Spine	3	4	5	3	46

Segment 15 has a moderately sized spinous process, segment 16 a minute process; both are placed at the middle of the segment. The setation of the left antennule agrees with that of the female.

The females of the Louisiana collection of *virginiensis* have a noticeable backwardly directed lobelike protrusion on the right side of the fifth metasomal segment (Figs. 11 and 12). The wings of the last segment are a little asymmetrical; the left may have the inner lobe well developed as shown in Fig. 12 or the entire margin may be nearly straight. The genital segment of the Louisiana specimens agrees with the type in not having the pronounced asymmetry and great lateral expansion found in the allied species; the lobe of the right side is usually only a little larger than that of the left, and there are no other expansions or modifications.

The antennule is of the "little setaceous" type, with one seta on segments 11 and 13–19. The seta of segment 1 reaches to about the middle of segment 2, and is nonplumose. There is a cuticular lappet on the second segment of the endopod of leg 2. The general aspect of the fifth leg is much like that of the new species described below, from which it usually differs in having the setae of the endopod extremely short.



FIGS. 1–10.—*Diaptomus louisianensis*, n. sp., female: 1, Metasome segments 5–6 and urosome, dorsal; 2, dorsal outline of body; 3, leg 1; 4, leg 1, detail spines of exopod segments 1 and 3; 5, leg 2, endopod segment 2; 6, maxilliped; 7, leg 5, detail endopod setae; 8, leg 5, with detail of setae of exopod 3; 9, leg 5, showing variation in length of endopod; 10, antennule, detail of setae of segments 1–3; 11, Metasome segments 5–6, right side, lateral; 12, metasome segments 5–6 and urosome of ovigerous specimen, dorsal.
FIGS. 11–12.—*Diaptomus virginiensis* Marsh, female (St. Landry Parish, La.):

Diaptomus (Onychodiaptomus) louisianensis, n. sp.

Figs. 1–10; 13–20

Specimens examined.—Type lot: 6 ♀, 1 ♂, ditch in Chicot State Park, Evangeline Parish, La., December 27, 1950, W. G. Moore. Holotype ♀ (whole, alcoholic), U. S. N. M. no. 93271.

7 ♂, ditch pond, south of Lebeau, St. Landry Parish, La., April 5, 1951, W. G. Moore.

Female.—Length, about 1.85 mm (metasome, 1.40 mm, urosome, 0.45 mm). Dorsal view: head rounded (Fig. 2), cephalic segment behind antennal area greatly widened, its distal portion and segments 2–4 nearly parallel; the greatest width in segment 2, equaling about 30 per cent of the total body length. Segments 5 and 6 not separated dorsally, the right side of segment 5 differing slightly from the left, having the distal half more rounded. The wings of the last segment well developed (Fig. 1), noticeably asymmetrical, that of the left side without lobes, the posterior margin nearly straight; the right side having a conspicuous lobe on both the outer and inner proximal portion, the tip drawn out to a point.

The urosome 3-segmented (Fig. 1). The genital segment having each side of the proximal portion produced into conspicuous lateral lobes tipped with stout sensory spines, the lobe of the right side larger and more rounded than that of the left. Segment 2 short; segment 3 and the caudal rami subequal in length to one another; both margins of the rami armed with hairs. The inner dorsal seta nearly as long as the inner terminal caudal seta.

Antennules reaching to near the end of the urosome. The seta of segment 1 reaching to a little beyond the middle of segment 3, its tip plumose (Fig. 10); that of segment 3 subequal to that of 1. The numerical setation as in other species of *Onychodiaptomus*: 1 seta on segments 11 and 13–19. The setae of segments 16, 18 and 21 of considerable length and stoutness, all conspicuously plumose; that of 16 reaching to the middle of segment 20; that of 18 to the middle of 22. The short, modified setae of segments 17, 19, 20, 22 not particularly stiff, their tips straight and slender, each longer than or nearly as long as its segment.

The maxilliped (Fig. 6) not stoutly developed; each basal segment and the endopod subequal to one another; the inner setae of the endopod all weakly developed, shorter than the endopod and the terminal and outer setae of the last two segments, the longest of which are about as long as the endopod itself. The distal lobe of the basal segment conspicuously produced, with four setae. The relative lengths of the setae of the basal segment:

lobe 1	lobe 2	lobe 3	lobe 4
20	17:20	15:10:23	15:9:7:10

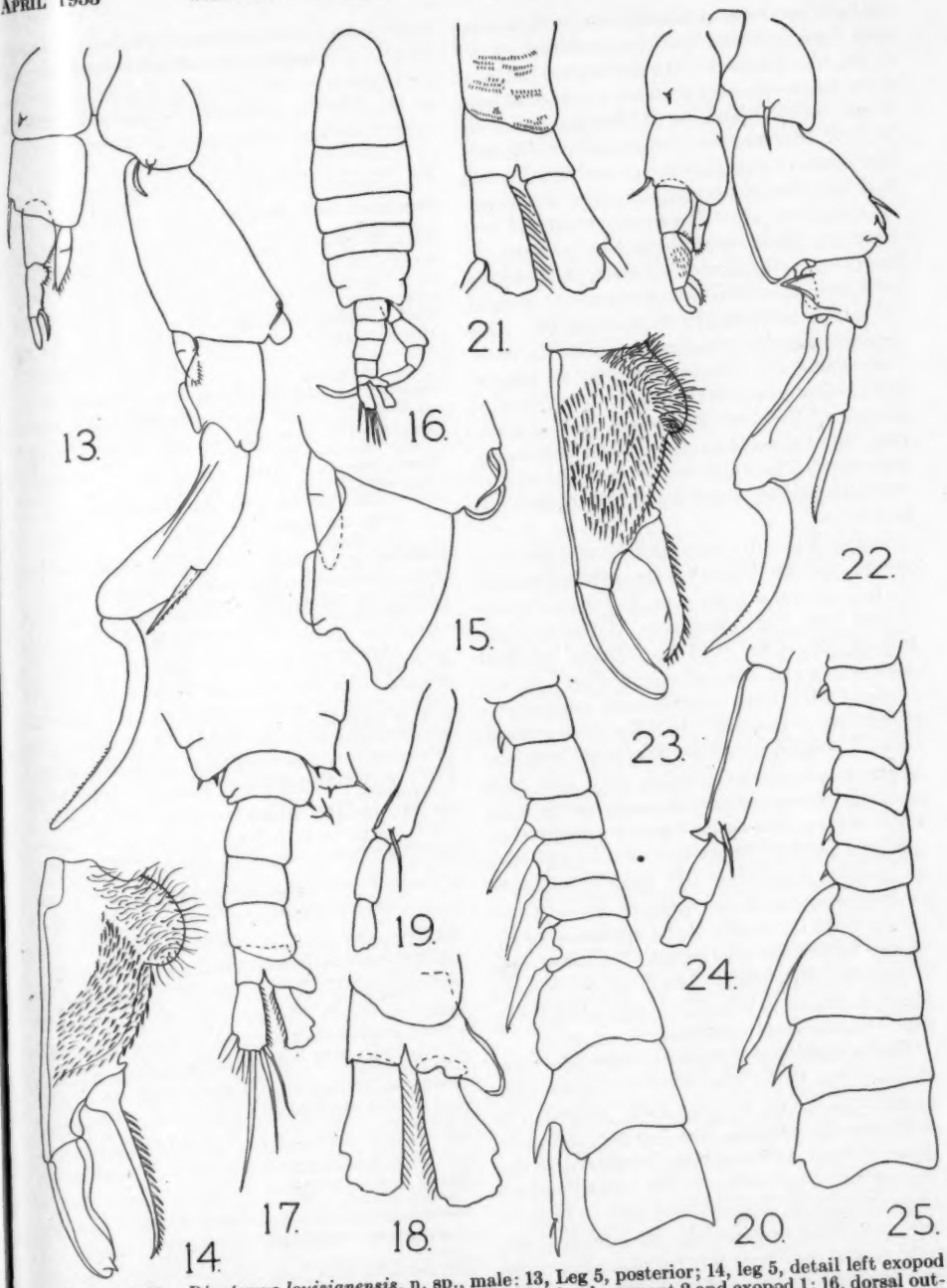
Leg 1 (Fig. 3) having fine, inconspicuous hairs on the outer margins of exopod segments 2 and 3. The outer spines of segments 1 and 3 spiniform (Fig. 4), both relatively weak and short, proportions to one another, 5:7; both with minute marginal serrations and tipped with sensory hairs. The outer terminal modified seta not at all spiniform, longer than the total exopod (50:40), a little weaker and shorter than the other setae of the segment, its outer margin minutely serrate, its inner plumose.

Leg 2 with a cuticular lappet on the second segment of the endopod (Fig. 5).

Leg 5 (Fig. 8) rather stout, the spine of the basal segment large and flat. The first exopod segment broad, greatest width to length of outer margin about 17:30. Exopod 2 longer than exopod 1 (35:30), with long, slender spinules on the inner margin. Outer seta of segment 2 not present. Exopod 3 not developed, its setae present, very closely set; the outer a stout spine, the inner a more slender seta about twice the length of the outer, and reaching to near the middle of exopod 2.

The endopod long, reaching a little beyond (Fig. 8), or considerably beyond the inner margin of exopod 1 (Fig. 9); its inner margin produced to a conspicuous protrusion armed with spinules which continue on to the face of the endopod. The apical setae sinuous (Fig. 7), their bases a little enlarged, one a little stouter than the other; their length usually less than half that of the endopod.

Male.—Length about 1.33 mm. The head rounded as in female, the rest of the metasome not so abruptly widened (Fig. 16). Segments 5 and 6 not separated dorsally, the posterior portions of segment 6 with 2 spines. The genital segment with a slender spine on the right side. The urosome conspicuously asymmetrical in the distal portion (Figs. 17 and 18). Segment 4 considerably produced dorsally on the right side; segment 5 having the right side produced laterally into a large, backwardly directed, marginally sclerotized lobe. The left caudal ramus straight,



FIGS. 13–20.—*Diaptomus louisianensis*, n. sp., male: 13, Leg 5, posterior; 14, leg 5, detail left exopod segment 2, posterior; 15, leg 5, detail distal part of right basipod segment 2 and exopod 1; 16, dorsal outline of body; 17, metasome segments 5–6 and urosome, dorsal; 18, detail of urosome segments 4–5 and caudal rami, dorsal; 19, right antennule, apical segments; 20, right antennule, segments 8–16.

FIGS. 21–25.—*Diaptomus virginiensis* Marsh, male (St. Landry Parish, La.): 21, Detail of urosome segments 4–5 and caudal rami, dorsal; 22, leg 5, posterior; 23, leg 5, detail left exopod segment 2, posterior; 24, right antennule, apical segments; 25, right antennule, segments 8–16.

the right narrowed proximally and widened distally; both rami with inner marginal hairs.

The left antennule with the same setation as in the female; the seta of segment 1 reaching only to the middle of segment 2. The right antennule (Fig. 20) with the spine of segment 8 not enlarged. The spines of segments 10, 11 and 13 all longer than the width of their segments, relative lengths of spines of two specimens: 18:23:24 and 16:21:25. The spine of 13 reaching to about the middle of 14. Segments 14–16 very swollen; segment 15 with a large spinous process arising at the middle and reaching to near the end of the segment; segment 16 lacking a process. The modified setae of 15–17 unusually stout, the tongue-like process very short and not arising close to the end of the seta. The twenty-third segment (Fig. 19) produced to a minute hook-like process, accompanied by a very narrow lamella.

Maxilliped, leg 1 and leg 2 like those of the female.

Leg 5 (Fig. 13) comparatively elongate and slender, the left ramus hardly reaching beyond the basipod of the right ramus. The sensory spines of both basal segments minute. The second basipod segment of the right leg elongate, its distal portion widened, but not conspicuously so, not swollen on the inner side, the outer portion produced into a rounded lobe (Fig. 15); a large, crescent shaped ridge on the inner proximal posterior face. Exopod 1 longer than wide; with a narrow rectangular hyaline lamella on the inner distal margin. The second exopod segment elongate and narrow (length to width 50:15); with an inner marginal ridge. The spine of the outer margin reaching to the apex of the segment, placed below the middle of the segment at about 68 per cent of its total length. The claw thick throughout, subequal in length to the exopod, 52:50. Endopod indistinctly 2-segmented, reaching to the middle of exopod 1.

The second basipod segment of the left ramus about as long as the first, broad throughout. The exopod set deeply into the basal segment, its width greatly reduced. The two segments subequal in length to one another (measuring to the base of the distal process). The apical segment (Fig. 14) having the proximal pad reduced in size, protruding medially but not extending distally to the middle of the segment. The distal pad confined to the posterior face, its medial and distal boundaries outlined below by heavy

TABLE 1.—COMPARISON OF CHARACTERS OF *Diaptomus sanguineus* GROUP

Character	*sanguineus*	*virginiensis*	*louisianensis*	*kenyensis*
♀ *Metasome*				
Segment 5 with right lateral protrusion	—[1]	+[1]	—	—
Segment 6 with elongate spines	+	—	—	—
"Wings" strongly asymmetrical	—	—	+	—
♀ *Urosome*				
3-segmented	+	+	+	—
Genital segment strongly asymmetrical	+	—	+	—
♂ *Urosome*				
Segment 4 strongly asymmetrical	—	—	+	—
Segment 4 with dorsal spinules	—	+	—	—
Segment 5 strongly produced, right side	—	—	+	+
♂ *Right Antennule*				
Spines:				
8: enlarged	+	—	—	—
10–11: as long as or a little longer than segment width	+	—	+	+
13: reaching to end of 14 or beyond	—	+	—	—
Processes:				
15: present	+	+	+	+
16: present	—	+	—	+
♂ *Leg 5, right*				
Basipod 2 greatly broadened	+	+	—	—
Basipod 2 with outer elongate process	+	—	—	—
Lamella exopod 1 prominent	—	+	—	+
Lamella shape	narrow, rounded	triangular	narrow, rectangular	tongue-like
Exopod 2, lateral spine below middle of segment	+	—	+	+
♂ *Leg 5, left*				
Distal pad posterior only (not bulging medially)	+	+	+	—
Inner process arising below proximal pad	—	—	—	+
Inner process reaching to near end of distal (forming pincer)	+	+	+	—
♀ *Leg 5*				
Slender (length exopod 1 more than 3 times width)	—	—	—	+
Inner seta of exopod 3 reaching beyond middle of claw	+	—	—	—
Endopod setae more than half length of endopod	—	—	—	+

[1] + refers to the presence of a character, — to its absence.

sclerotizations, the short stout hairs recumbent and curving toward the outer margin. The distal process continuous with but clearly demarcated from the segment, its length about one half of the outer margin of the segment, digitiform, curving inwards, the cuticle at its tip notched so as to form a short spinous projection. The inner process arising below the distal pad, its base thickened but otherwise very slender, curving toward and reaching to near the end of the distal process so as to form a pincer; set thickly with spinules on the inner side only; the heavy sclerotized medial portion of the segment produced at its base into a characteristic point.

The endopod reaching to about the middle of exopod 2; indistinctly 2-segmented, its anterior face and medial margins set thickly with stout spinules.

COMPARISON OF SPECIES OF THE SANGUINEUS GROUP

The subgenus *Onychodiaptomus* Light (1939) may be divided by the structure of the male right fifth leg into two convenient taxonomic groups: the *birgei* and the *sanguineus*. In *Diaptomus birgei*, the only known species of its group, the second basipod segment and the exopod, including the claw, differ from the *sanguineus* group, except for the presence of a prominent hyaline lamella on the inner portion of exopod 1. In all other characters, both sexes of *birgei* show unmistakable relationship to the *sanguineus* group. Coker (1926) and Kiefer (1931) have given useful descriptions of *birgei*. The conspicuous ventral lobe found in the female distad to the genital protrusion, is not present in the other species of the subgenus.

The *sanguineus* group includes four species: *D. sanguineus* Forbes, 1876; *D. virginiensis* Marsh, 1915; *D. hesperus* M. S. Wilson and Light, 1951; and *D. louisianensis*, n. sp.

These species agree in the similarity of pattern of the right male fifth leg which is characterized by modification of the second basipod segment and shortness of the claw. The species differ from one another most noticeably in the structure and armature of the second basipod segment and the shape and size of the lamella of exopod 1. There are definable differences in the left exopod. *D. hesperus* is strikingly diverse in that the inner process is so placed that it does not form a pincer with the distal process as in the other species; in this, it is more like *D. birgei*.

Diaptomus sanguineus is a well-defined species; its important diagnostic characters have been reviewed by Humes and Wilson (1951). Louisiana specimens show no significant differences from the Massachusetts specimens studied in that report. The female is easily distinguished from all other North American diaptomids by the unique development of the last metasomal segment, which is not expanded into the usual "wings" but instead has both sensory spines greatly enlarged. Throughout its wide distributional range there is no variation in this character, except for slight differences in the length of the spines. The male is distinguished by the elongation of the usual short spine on segment 8 of the right antennule and by the spiniform elongation of the outer distal corner of the right second basipod segment of the fifth leg. Though variable in length, this process is specifically distinct and differs from the modification or armature found in the other species.

Table 1 gives a summary of the useful taxonomic characters separating the species.

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ICHTHYOLOGY.—*The blenniid fish genera* Cirripectus *and* Exallias *with descriptions of two new species from the tropical Pacific.*[1]

DONALD W. STRASBURG, University of Hawaii, and LEONARD P. SCHULTZ, U. S. National Museum.

Schultz (Copeia 1941 (1): 17–20) recognized four species of *Cirripectus*, among which were *C. leopardus* and *C. brevis*. Chapman (*in* de Beaufort and Chapman, The fishes of the Indo-Australian Archipelago, **9:** 246–255. 1951) recognized three species of *Cirripectus*: *C. leopardus* (Day), *C. variolosus* (Cuvier and Valenciennes), and *C. sebae* (Cuvier and Valenciennes). In his discussion two extralimital species were recognized, *C. quagga* (Fowler and Ball) and *C. brevis* (Kner).

Further study of these species, based on many additional specimens, indicates conclusively that both Schultz and Chapman misinterpreted Kner's description and figure of *C. brevis*. We now find that *leopardus* must be referred to the synonymy of *brevis* and that the species distinguished by Schultz (l.c., p. 19) as *brevis* is a new species.

This contribution distinguishes as valid the genus *Exallias* and summarizes the chief differences between it and *Cirripectus*. Also two new species are described from the tropical Pacific. We do not consider this study as a review of the genera, since adequate material is not available. We lack specimens from the western Indian Ocean and from several island groups in the tropical Indo-Pacific Oceans.

The following analysis indicates the chief differences between *Cirripectus* and *Exallias*:

1*a*. A pair of barbels on underside of throat, each side of middle of chin; teeth in upper jaw very numerous, fine, flexible, those in lower jaw numerous, moderately flexible, about twice as broad as those in upper jaw and about one-third as many; no canines; least distance between eye and nuchal fringe contained 2½ or more times in postorbital length of head; soft rays of dorsal fin 12 or 13 and anal 14 or 15; upper lip with short barbels.....*Exallias* Jordan and Evermann

1*b*. No barbels on underside of head; teeth in both jaws very numerous, fine, flexible, and of approximately same size; one or two canine teeth present at each side of lower jaw; least distance between eye and nuchal fringe contained fewer than two times in postorbital length of head; soft rays of dorsal 14 to 16 and of anal 15 to 17; upper lip crenulate or nearly so.....*Cirripectus* Swainson

Because *Exallias* has been confused with *Cirripectus* since it was proposed, a summary of the nomenclature for the two genera is important as well as that for the single species referable to *Exallias*.

Genus **Exallias** Jordan and Evermann

Exallias Jordan and Evermann, Bull. U. S. Fish Comm. **23** (for 1903): 503. 1905 (type, *Salarias brevis* Kner).

Gloriella Schultz, Copeia 1941(1): 17 (type, *Cirripectes caninus* Herre).

Exallias brevis (Kner)

Salarias brevis Kner, Sitz. Akad. Wiss. Natur. **58**: 42, pl. 6, fig. 18. 1868 (type locality, Savaii, Samoa); Weber, *Siboga* Exped. Fische: 537. 1913 (Karakelang Island).

Cirripectes brevis Fowler, Mem. B. P. Bishop Mus. **10**: 432. 1928 (Hawaii; Marshall Islands; Kingsmill Islands).

Salarias leopardus Day, Proc. Zool. Soc. London 1869: 518 (type locality, Ceylon).

Blennius leopardus Day, Fishes of India **2**: 325, pl. 68, fig. 5. 1876 (Ceylon).

Cirripectes leopardus Schultz, Copeia 1941(1): 19 (Oahu); U. S. Nat. Mus. Bull. 180: 272–273. 1943 (Oahu and Rose Islands); Chapman (*in* de Beaufort and Chapman) Fishes of the Indo-Australian Archipelago **9**: 247–249, fig. 43. 1951 (Moluccas, Talaut, Marshalls, Hawaiian and Samoan Islands).

Cirripectes caninus Herre, Philippine Journ. Sci. **59**(2): 284. 1936 (type locality, Ternate Island, Moluccas); **70**(4): 342. 1939 (Ternate Island).

Gloriella canina Schultz, Copeia 1941(1): 18 (Ternate Island).

Genus **Cirripectus** Swainson

Cirripectus Swainson, Nat. Hist. Fishes **2**: 79–80 (*Cirripectes* on pp. 182, 275) 1839 (type, *Salarias variolosus* Cuvier and Valenciennes); Norman, Ann. Mag. Nat. Hist. (11)**10**: 810. 1943; Chapman, Fishes of the Indo-Australian Archipelago **9**: 246. 1951.

Cirripectes Schultz, Copeia 1941(1): 18 (type, *Salarias variolosus* Cuvier and Valenciennes).

During the progress of this study numerous counts and measurements have been made on various species of *Cirripectus* and *Exallias*. These are recorded in Tables 1 to 3 and should be used along with the keys.

[1] Contribution No. 28, Hawaii Marine Laboratory.

Our methods of counting fin rays and the number of cirri need describing. Each fin ray with a separate and distinct base was counted as one ray, those rays split to a single base were also counted as one. Females that are past the *Ophioblennius* stage have the first anal spine embedded in the tissue around the genital region. This spine was evident only by dissection. Sexually mature males have the distal part of the two anal spines developed into a knob, consisting of convoluted spongy tissue.

Each nuchal and supraorbital cirrus, including those forming double rows in certain cases, was counted as one cirrus if it had a single base; thus a cirrus deeply bifurcate distally or near its tip only was counted as one.

The problem of interpreting the significance of a single supraorbital cirrus must be considered on the basis of variability for each species. The supraorbital cirrus of *C. jenningsi* is simple, slender, and very, very rarely slightly bifurcate at its tip. This cirrus is never a broad flap as in certain other species. The supraorbital cirrus of *C. quagga* has a constricted base, thence broadening distally. It may be a simple dermal flap as in many young specimens, or the flap may be bifurcate or with multifid cirri in adults; the potential cirri in this species may appear as fleshy ridges in the dermal flap later becoming separated into distinct cirri.

In the young or juveniles of *C. sebae*, *C. variolosus*, and *C. filamentosus* the supraorbital cirrus occasionally may be simple but in the adults it is usually multifid.

The above discussion indicates that some caution must be used in connection with the supraorbital cirrus for distinguishing certain species. In faded and in young specimens, *jenningsi* and *quagga* may be confused but these two species may be distinguished respectively by the number of times the snout length is contained in the least distance from eye to nuchal fringe, which is 0.7 to 0.8, and 1.0 to 1.3, respectively (see the key).

Cirripectus filamentosus, based on specimens from Arnhem Land, Australia, might be considered as a subspecies of *C. variolosus* on the basis of slightly more numerous rays in dorsal and anal fins and fewer nuchal cirri, if both sexes of adult specimens of *filamentosus* did not possess an elongate first dorsal spine. In *variolosus* only the adult males have an elongate first dorsal spine. We do not have sufficient material from localities between the Marianas, Marshalls, Phoenix and Samoan Islands, and Australia to study this problem adequately.

The following key does not include the *Ophioblennius* stages of the genera *Cirripectus* and *Exallias*:

KEY TO THE PACIFIC SPECIES OF EXALLIAS AND CIRRIPECTUS

1*a*. Teeth in lower jaw fixed or barely movable and about half as numerous and twice as broad as those in upper jaw; no lower canines; chin with pair of barbels adjoining pair of pores on each side; length of snout into least distance from eye to nuchal fringe 0.3 to 0.5 times; dorsal rays XII, 12 or 13; anal II, 14 or 15 (rarely 15); nuchal cirri 30 to 36 (see table); edge of upper lip with 12 to 24 (usually 18 to 24) barbel-like lappets; color pattern of blackish spots on paler background..... *Exallias brevis* (Kner)

1*b*. Teeth in lower jaw freely movable, of about same breadth and number as those in upper jaw; pair of lower canines present; chin without barbels; length of snout into least distance from eye to nuchal fringe 0.7 to 1.3; dorsal rays XII, 13 to 16 (rarely 13); anal II, 14 to 17 (rarely 14); edge of upper lip crenulate..... (*Cirripectus* Swainson).

2*a*. Body and pectoral fins everywhere covered with dark spots on paler background; nuchal cirri 47 to 62; dorsal rays XII, 14; anal II, 15. *Cirripectus fuscoguttatus*, n. sp.

2*b*. Body and pectoral fins not marked as in 2*a*; if dark spots are present they do not uniformly cover the body and pectoral fins; nuchal cirri 43 or fewer.

3*a*. Anterior half of body pale, spotted with darker; posterior half of body blackish, spotted with pale; supraorbital cirrus slender and simple; dorsal rays XII, 15; anal II, 15 or 16 (rarely 15); length of snout into least distance from eye to nuchal fringe 0.7 to 0.8 times. *Cirripectus jenningsi* Schultz[2]

3*b*. Color pattern not as in 3*a*.

4*a*. Color of head and body plain tan to dark brown, sometimes with scattered pale spots or dots on snout, cheeks, and upper lip; fins brown to blackish except sometimes anterodorsal part of spinous and soft dorsals and upper lobe of caudal pale or whitish.

5*a*. Nuchal cirri totaling 24 to 30 (see table); dorsal rays XII (very rarely XIII), 14 or 15; anal II, 15 or 16; first dorsal spine notably elongate

[2] *Cirripectes jenningsi* Schultz, U. S. Nat. Mus. Bull. **180**: 273–275, fig. 27. 1943 (type locality, Swains Island).

in adults of both sexes as short as 45 mm. standard length.

Cirripectus filamentosus (Alleyne and Macleay)[3]

5*b*. Nuchal cirri totaling 29 to 37 (see table); dorsal rays XII, 14; anal II, 14 or 15; first dorsal spine elongate only in adult males.

Cirripectus variolosus (Cuvier and Valenciennes)[4]

4*b*. Head and body not colored as in 4*a*.

6*a*. Dorsal rays XII, 13 or 14; anal II, 14 or 15; background coloration light tan to dark brown. *Young*, longitudinal dark stripe from behind eye to caudal fin base, sometimes broken into series of elongate blotches. *Adults*, with 5 to 12 vertical dark brown bars; throat, cheeks, and opercles usually with numerous roundish pale spots, size of pupil, enclosed in reticulated brown lines that resemble a honeycomb, sometimes the brown pigment is so extensive that light spots appear on a dark background.

Cirripectus sebae (Cuvier and Valenciennes)[5]

6*b*. Dorsal rays XII, 13 to 16 (rarely 13, 14); anal II, 15 to 17 (rarely 15).

7*a*. Head and body tan to dark brown with 8 to 15 vertical dark bars and frequently speckled with tiny black and white dots; narrow dark bar below center of eye, another behind lower rear edge of eye, the latter extending across lip and meeting its fellow on underside of head; narrow transverse dark streak across gill membranes on underside of head; streaks may be diffuse on large specimens; nuchal cirri 25 to 36 (see table); length of snout into least distance from eye nuchal fringe 1.0 to 1.3 times.

Cirripectus quagga (Fowler and Ball)[6]

7*b*. Head and body dark brown or blackish; no vertical dark bars or streaks near eye or across gill membranes; color pattern consisting of conspicuous roundish pale spots, size of pupil, enclosed in reticulated brown lines that resemble a honeycomb, sometimes brown pigment is so extensive that light spots appear on a dark background; this pattern confined to throat, breast and sides of head in males but sometimes extending posteriorly as far as the fifth or sixth soft dorsal ray in females; large males have the posterior half to two-thirds of sides of body with numerous white markings that vary from round white dots or small spots to elongate ones or white lines that extend vertically, obliquely, or horizontally; some of elongate lines may run together; posteriorly both sexes may have scattered pupil-sized blackish spots or short lines on a dark background; nuchal cirri 32 to 42 (see table).

Cirripectus stigmaticus, n. sp.

[3] *Salarias filamentosus* Alleyne and Macleay, Proc. Linn. Soc. New South Wales **1:** 337, pl. 14, fig. 1. 1877 (type locality, Cape York).

[4] *Salarias variolosus* Cuvier and Valenciennes, Hist. Nat. Poiss. **11:** 317. 1836 (type locality, Guam).

[5] *Salarias sebae* Cuvier and Valenciennes, Hist. Nat. Poiss. **11:** 323. 1836 (type locality, East Indies).

[6] *Rupiscartes quagga* Fowler and Ball, Proc. Acad. Nat. Sci. Philadelphia **76:** 273. 1924 (type locality, Wake Island).

Cirripectus fuscoguttatus, n. sp.

Fig. 1

Cirripectes brevis (non Kner), Schultz, Copeia 1941(1): 19–20; U. S. Nat. Mus. Bull. 180: 272–273. 1943 (Enderbury and Tutuila Islands); Chapman, Fishes of the Indo-Australian Archipelago **9:** 249 (note). 1951.

Holotype.—U.S.N.M. no. 113634. Rongerik Atoll, Eniwetak Island, Ocean reef in surf, June 29, 1946, S-46-241, Schultz and Herald, standard length 68 mm.

Paratypes (lots not bearing U.S.N.M. numbers have been distributed to other museums).—Bikini Atoll, Namu Island, Ocean reef, April 4, S-46-51, Schultz, 5 specimens 42 to 53 mm in standard length; Bikini Atoll, Bokon Island, April 15, S-46-94, Schultz and Brock, 9 specimens 34 to 80 mm; U.S.N.M. no. 142103, Bikini Atoll, Airy Island, April 16, S-46-96, Schultz, 16 specimens, 23.5 to 84 mm; U.S.N.M. no. 142102, Bikini Atoll, Eman Island, July 19, 1947, S-46-441, Schultz, Brock, Myers, and Hiatt, 10 specimens, 19 to 94 mm; Bikini Atoll halfway between Bikini and Amen Islands, July 21, 1947, S-46-442, Brock, Hiatt, and Schultz, 1 specimen, 72 mm; Bikini Atoll, Enyu Island, August 1, 1947, S-46-483, Schultz, Brock, and Hiatt, 2 specimens 73 to 76 mm; Bikini Atoll, Namu Island, August 6, 1947, S-46-508, Schultz, Brock, and Hiatt, 2 specimens, 91 to 95 mm; Bikini Atoll, Bikini Island, August 18, 1947, S-46-533, Brock and Schultz, 2 specimens, 93 to 99 mm; Bikini Atoll, Namu Island, August 7, 1947, S-1019, Brock, Hiatt, and Schultz, 2 specimens, 77 to 92 mm; U.S.N.M. no. 142106,

Rongerik Atoll, Eniwetok Island, June 29, S-46-241, Schultz and Herald, 12 specimens, 21 to 81 mm; U.S.N.M. no. 142104, Eniwetok Atoll, Mui Island, May 28, S-46-186, Schultz, 35 specimens, 22 to 100 mm; Eniwetok Atoll, Giriinien Island, May 29, S-46-187, Schultz, 1 specimen, 81 mm; U.S.N.M. no. 142105, Kwajalein Atoll, Ennylabegan Island, September 1, 1946, S-46-397, 1 specimen, 72 mm; U.S.N.M. no. 115497, Tutuila Island, Fagasa Bay, rock pools, June 5, 1939, Schultz, 1 specimen, 73 mm; U.S.N.M. no. 115498, Enderbury Island, reef, May 15 to 19, 1939, Schultz, 5 specimens, 73 to 89 mm; U.S.N.M. no. 164960, Gilbert Islands, Onotoa Atoll, July–August 1951, lagoon and ocean reefs, Randall and Strasburg, 2 specimens, 60 to 79 mm.

Description.—Certain counts were made of the holotype and paratypes and these data are

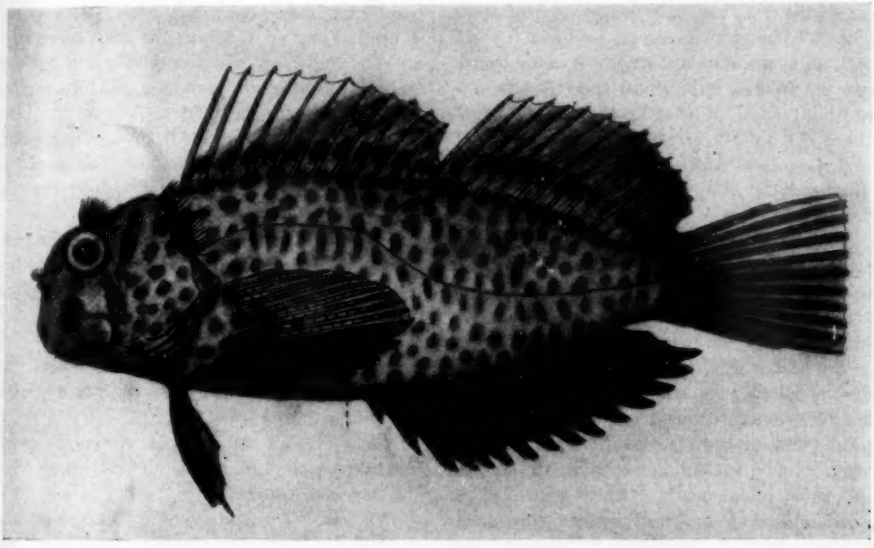

FIG. 1.—*Cirripectus fuscoguttatus*, n. sp.: Holotype (U.S.N.M. no. 113634), 68 mm. in standard length.

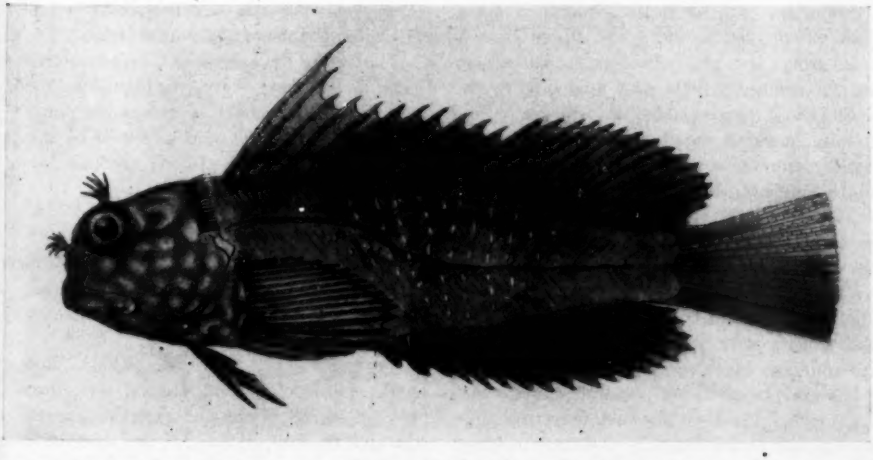

FIG. 2.—*Cirripectus stigmaticus*, n. sp.: Holotype (U.S.N.M. no. 164962), 63 mm. in standard length.

recorded in Table 1. Detailed measurements were made on the holotype, and these data, expressed in thousandths of the standard length, are recorded in Table 2.

Dorsal rays XII, 14; anal II, 15 (first anal spine embedded in females); pectoral 15 (with lower 5 or 6 thickened); pelvics I, 4; branched caudal rays 5 + 4; fringe of cirri on nape 47 to 62; nasal cirri 4 to 12, and orbital cirri 8 to 18 (more cirri on large adults). Head 3.0 to 3.2; greatest depth 3.2 to 3.5; longest dorsal spine 4.8 to 5.7; longest thickened pectoral ray 3.7 to 4.0; all in the standard length. Eye 3.0 to 5.0; snout 2.3 to 2.8; interorbital space 7.0 to 9.0; postorbital length of head 1.6 to 1.7; least depth of body 2.6 to 3.0; greatest depth of body 1.0 to 1.2; preorbital width 4.5 to 6.0; all in length of the head.

Orbital tentacle with a broad flattish base, its distal edge somewhat folded with numerous long cirri, more in adults; nuchal band of cirri simple, those at middorsal line about same length as those laterally, nuchal band of cirri curving posteroventrally so that the distance between vertical lines thru ventrolateral basal tip and anterodorsal edge is contained 4.6 to 5.6 times in postorbital length of head; ventral basal end of nuchal band of cirri blackish, notably swollen even in young, extending ventrally to opposite pupil; snout profile nearly vertical; edge of upper lip with numerous very short papillae or crenulate in young; lower lip shallowly plicate; no cirri on chin; lateral line arched over pectoral fin then curving to midlengthwise axis of body, ending at caudal fin base; a vertical line thru dorsal origin passes just behind lower tip of base of nuchal fringe and just behind pelvic bases; pectoral fin reaches a little past anal origin; anal spines two, first embedded in females, except juveniles; in adult males both anal spines with grayish crenulate and convoluted swollen dermal pads; a canine tooth present on each side of lower jaw; teeth in both jaws very numerous, of equal size, and moveable; sixth pectoral ray from lowermost edge of fin longest; distal edge of caudal fin a little rounded.

Color in alcohol.—Background color brown to light brown; body and head profusely covered with roundish black spots, usually absent from all fins except basally on pectorals; all fins very dark brown or blackish. The color pattern changes with size as follows: From 19 to 30 mm in standard length the black spots are barely discernible and few in number, the background color is chiefly plain brownish and dark and light bands on the head are becoming developed. In those 30 to 40 mm there is a prominent V-shaped brown mark on front of snout, which is separated by a narrow white band from next black band extending from below eye across upper lip to meet its fellow on chin, there forming a triangular spot; just behind this is a wide white band extending from behind eye across cheek through rear of maxillary meeting its fellow under head; this pale band set off sharply by dark brown color of rear of head. From 40 to 55 mm the large black spots on head and body are prominent, and the pale and dark bands on head are still discernible. Between the lengths of 55 to 70 mm, the black bands on head begin to break up into dark spots, and in those longer than 70 mm, the bands are no longer distinct having broken into roundish to oblong spots.

The nuchal fringe consists of black cirri, with a very blackish swollen basal area at lateral tips, even in the 19 mm specimen; the two anal spines on adult males have swollen dermal pads light grayish in color.

Color when alive.—Background color dark brown, spots blackish; eye crimson (iris); upper edge of caudal fin orange.

Ecology.—This moderately common species was taken in the Lithothamnium ridge area where the surf was strong.

Remarks.—The statement by Chapman (l.c., p. 249) that the two species *"leopardus"* and *"brevis"* (now *fuscoguttatus*) occur side by side in the Marshalls, Hawaii, and Samoa is incorrect. *C. fuscoguttatus* has not been collected in the Hawaiian Islands or at Johnston Island.

The key to the species of *Cirripectus* gives the essential characters and distinguishes *fuscoguttatus* from other related species in the genus.

Named *fuscoguttatus* in reference to the profusion of brown spots on body and fins.

Cirripectus stigmaticus, n. sp.
Fig. 2

Holotype.—U.S.N.M. no. 164962, Rongerik Atoll, Latoback Island, lagoon reef, June 28, 1946, S-46-238, Schultz and Herald, male, standard length 63 mm.

Paratypes.—U.S.N.M. no. 164963, Rongerik Atoll, Latoback Island, lagoon reef, June 28, 1946, S-46-238, Schultz and Herald, 2 specimens, 62 and 66 mm; U.S.N.M. no. 164964, Bikini Atoll, lagoon reef half way between Bikini and Amen Islands, July 21, 1947, S-46-442, Brock,

TABLE 1.—COUNTS RECORDED FOR SPECIES OF *Cirripectus* AND *Ezallias* FROM THE MARSHALL, GILBERT, PHOENIX, AND SAMOAN ISLANDS.

TABLE 1.—COUNTS RECORDED FOR SPECIES OF *Cirripectus* AND *Exallias* FROM THE MARSHALL, GILBERT, PHOENIX, AND SAMOAN ISLANDS.

Number of fin rays

Genus and species	Dorsal XII	Dorsal XIII	Dorsal 12	Dorsal 13	Dorsal 14	Dorsal 15	Dorsal 16	Anal II	Anal 14	Anal 15	Anal 16	Anal 17	Pectoral 13	Pectoral 14	Pectoral 15	Pectoral 16
Exallias brevis[1]	29	—	4	25	—	—	—	29	27	2	—	—	—	—	42	—
Cirripectus;																
fuscoguttatus, n. sp.	26	—	—	—	26	—	—	26	—	26	—	—	—	—	41	—
variolosus	30	—	—	—	30	—	—	30	1	29	—	—	—	—	28	—
sebae	85	—	—	2	83	—	—	85	2	83	—	—	—	4	108	8
filamentosus[2]	34	1	—	—	10	25	—	35	—	9	26	—	2	5	61	2
jenningsi[3]	24	—	—	—	—	24	—	24	—	1	23	—	—	1	47	—
quagga[4]	29	—	—	1	1	27	—	29	—	3	24	1	—	2	49	—
stigmaticus, n. sp.	28	—	—	—	1	26	1	28	—	1	27	—	—	3	42	1

Number of cirri — Nuchal

Genus and species	24-25	26-27	28-29	30-31	32-33	34-35	36-37	38-39	40-41	42-43	44-45	46-47	48-49	50-51	52-53	54-55	56-57	58-59	60-61	62-63
Exallias brevis[1]				2	8	16	3													
Cirripectus;																				
fuscoguttatus, n. sp.												2	1	6	9	5	1	1		2
variolosus			1	11	11	4	2													
sebae					3	11	24	24	16	7										
filamentosus[2]	7	18	8	2																
jenningsi[3]		1				2	3	7	6	5										
quagga[4]	1	4	5	12	5		1													
stigmaticus, n. sp.					1	5	8	8	4	2										

Number of cirri — Supraorbital

Genus and species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Exallias brevis[1]				2	6	5	14	4	14	6	4	1	1			1		
Cirripectus;																		
fuscoguttatus, n. sp.								2		1	2	3	7	8	2	3	1	3
variolosus	1		13	34	6	4		2										
sebae	3	11	26	38	45	31	12	4										
filamentosus[2]	2	23	36	8	1													
jenningsi[3]	48																	
quagga[4]	16	11	14	12	3	1		1										
stigmaticus, n. sp.				8	15	21	7	3	1	1								

[1] These data include counts made on 15 specimens from Johnston Island and the Hawaiian Islands.
[2] All counts made on specimens from Arnhem Land, northern Australia.
[3] Not taken in the Marshall Islands.
[4] Two specimens from Wake Island included in the counts.

TABLE 2.—THE LENGTH OF THE SNOUT INTO THE LEAST DISTANCE BETWEEN HINDBORDER OF EYE AND NUCHAL FRINGE

Genus and species	Ratio 0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3
Exallias brevis	2	10	1								
Cirripectus:											
fuscoguttatus, n. sp.					6	3		1			
variolosus							2	8	2		
sebae								10	2	1	
filamentosus								5	2	1	
jenningsi					4	5					
quagga								1	3	2	1
stigmaticus, n. sp.						2	6	2	1		

TABLE 3.—MEASUREMENTS, EXPRESSED IN THOUSANDTHS OF THE STANDARD LENGTH, MADE ON CERTAIN SPECIES OF CIRRIPECTUS

Characters	C. stigmaticus, n. sp. Holotype	C. stigmaticus, n. sp. Paratype	C. stigmaticus, n. sp. Paratype	C. fuscoguttatus, n. sp. Holotype	C. fuscoguttatus, n. sp. Paratype	C. fuscoguttatus, n. sp. Paratype
Standard length in millimeters	63.0	43.1	93.0	68	22	81
Head, tip of snout to rear of opercular membrane	291	309	291	316	332	321
Greatest depth of body	307	320	333	360	282	348
Least depth of body	113	114	116	129	109	123
Postorbital length of head	190	188	185	201	150	198
Diameter of eye	75	88	62	76	114	72
Snout tip or front of upper lip to eye	105	130	96	154	127	142
Fleshy interorbital space	30	23	38	37	41	37
Least distance from eye to nuchal fringe	114	97	104	106	109	107
Longest dorsal spine	289	241	190	210	154	216
Longest soft dorsal ray	217	218	202	225	173	216
Longest soft anal ray	156	144	165	206	141	183
Longest pectoral ray	252	262	215	313	259	284
Longest pelvic ray	181	200	174	235	218	198
Longest caudal ray	268	278	258	294	273	289
Snout tip to anus	510	534	556	486	559	518
Snout tip to dorsal origin	321	320	303	332	336	333
Length of anal fin base	413	410	468	404	382	251
Sex	♂	♂	♀	♀	—	♂

Hiatt, and Schultz, 2 specimens, 93 and 99.5 mm; U.S.N.M. no. 142129, Rongerik Atoll, Latoback Island, lagoon reef, August 14, 1947, Brock, Schultz, and Donaldson, 1 specimen, 82 mm; U.S.N.M. no. 164965, Apia, Samoa, Jordan and Kellogg, 1 specimen, 66.5 mm; U.S.N.M. no. 164961, Gilbert Islands, Onotoa Atoll, lagoon and ocean reefs, July–August 1951, John E. Randall and Donald W. Strasburg, 16 specimens, 36 to 76 mm; U.S.N.M. no. 154674, Marshall Islands, Arno Atoll, lagoon reef, June–September 1950, Donald W. Strasburg and Robert W. Hiatt, 3 specimens, 67 to 81 mm; U.S.N.M. no. 154673, Marshall Islands, Arno Atoll, ocean reef, June–September 1950, Donald W. Strasburg and Robert W. Hiatt, 2 specimens, 45 to 56 mm.

Description.—Certain counts are recorded in Table 1. Detailed measurements were made on the holotype and two paratypes, and these data are expressed in thousandths of the standard length in Table 3.

Dorsal rays XII, 14 to 16, rarely 14 or 16; anal II, 15 or 16, rarely 15 (first anal spine embedded on females); pectoral 14 to 16, rarely 14 or 16 (with lower 5 or 6 thickened); pelvics I, 4; branched caudal rays 5 + 4; fringe of cirri on nape 32 to 42, generally 35 to 42; nasal cirri 4 to 6; supraorbital cirri 4 to 10 (more cirri on large adults).

Head 2.9 to 3.1; greatest depth 3.1 to 3.3; longest dorsal spine (first) 1.9 to 2.9 (the first dorsal spine is elongate in adult males); longest thickened pectoral ray 2.1 to 2.6; all in the standard length. Eye 3.5 to 4.7; snout 2.4 to 3.1; interorbital space 7.7 to 13.3; postorbital length of head 1.5 to 1.7; least depth of body 2.5 to 3.0; greatest depth of body 0.87 to 0.96; all in the length of the head.

Orbital tentacle with a broad flattened base, its distal edge with numerous long cirri, more in adults; nuchal band of cirri simple, those at middorsal line about same length as those laterally, nuchal band of cirri curving posteroventrally so that the distance between vertical lines through ventrolateral basal tip and anterodorsal edge is contained 4.6 to 6.5 times in postorbital length of head; ventral basal end of nuchal band of cirri is notably swollen and flattened even in young; it is blackish and bears the lowermost 8 or 9 cirri, and extends ventrally to about upper edge of pupil; snout profile nearly vertical; edge of upper lip with numerous short papillae or crenulate in young; lower lip with mesial third smooth, lateral third on each side somewhat plicate; no cirri on chin; lateral line arched over pectoral fin then curving to midlengthwise axis of body, ending at caudal fin base; vertical line through dorsal origin passes just behind ventral tip of nuchal fringe base and just behind pelvic bases; pectoral fin reaches a little past anal origin; anal spines two, first embedded on females past the *Ophioblennius* stage, both free on males; adult males have crenulate and convoluted spongy masses on these spines; a canine tooth present on each side of lower jaw; teeth in both jaws very numerous, of about equal size in both jaws, and movable; fifth or sixth pectoral ray from lowermost edge of fin longest; distal edge of caudal fin a little rounded.

Color in alcohol.—Background color brown to blackish; vertical fins dark and unmarked except for anterodorsal part of the spinous dorsal, the distal tips of the first few soft dorsal rays, and the upper lobe of the caudal which may be pale or whitish; anal somewhat darker than body or other fins, pelvics dusky, pectorals dusky ventrally, paler dorsally.

The color pattern changes with size as follows: The smallest specimen available (35.8 mm in standard length) has the background color brown with the cheeks, opercles and sides of the body posteriorly to the tip of the depressed pectoral overlaid with round pale spots about the size of the pupil. Posterior to the pectoral tips these spots are enlarged so much that the surrounding brown areas have the appearance of irregular lines on a pale background. The vertical fins of this specimen are pale brown basally becoming almost transparent in their distal half to two-thirds. The spinous dorsal is marked with a dusky lengthwise stripe along its basal third; this demarks the distal pale area mentioned above.

In specimens above 40 mm in standard length the characteristic, although somewhat variable, adult color pattern has been attained. The roundish pupil-sized pale spots are much more distinct, sometimes they are enclosed in reticulated brown lines that resemble a honeycomb, and sometimes the brown pigment is so extensive that the spots appear to be on a dark background. The nuchal fringe consists of black cirri with a swollen, very blackish basal area laterally.

The distribution of the spots and other markings varies with sex as follows: *Males:* Spots on preorbitals and suborbitals, cheeks, opercles, entire under side of head and throat, and extending

posteriorly on the pectoral bases. The posterior one-half to two-thirds of the sides of the body are covered with numerous white markings that may vary from round white dots or small spots to elongate ones or white lines that extend vertically, horizontally or obliquely; some of these lines may run together. There may be a few blackish pupil-sized dots or irregular markings on the sides of the caudal peduncle. The dermal pads on the anal spines of males are grayish to blackish in color. *Females:* Pale spots as in males; in addition they may extend as far posteriorly as the fifth or sixth dorsal soft ray. Posterior to this the spots give way to plain dark color or there may be irregular blackish dots or short lines on a dark background.

Color when alive.—Background color brown to blackish, anterior spots pale brown, sides of males covered with bright red dots or elongate spots or lines; anterodorsal tip of first and second dorsals and upper lobe of caudal reddish orange to white.

Ecology.—This rather uncommon species was taken in the Lithothamnium ridge area or areas of *Acropora* and *Pocillopora* corals where the surf was moderate to strong.

Remarks.—The key to the species *Cirripectus* distinguishes *stigmaticus* from all related species in the genus.

Named *stigmaticus* in reference to the white and dark spots.

Obituaries

Paul Ardeen Neal, medical director, United States Public Health Service, died on October 13, 1952, after a brief illness.

Dr. Neal, who was chief of the Laboratory of Physical Biology in the National Institutes of Health at the time of his death, entered the Public Health Service immediately after obtaining his medical degree from Vanderbilt University in 1927. He interned in U. S. Marine Hospital at New Orleans; received his Commission in the Service June 30, 1928; and during the following year was assigned to the Marine Hospital at Mobile, Ala.

From 1929 to 1933 Dr. Neal was attached to various United States Consulates abroad, in Ireland, Germany, Poland, Denmark, and Italy. He began his research career when, in 1934, he was assigned to the Division of Scientific Research to serve under Dr. R. R. Sayers in the Office of Industrial Hygiene and Sanitation. This marked the beginning of his active interest in the study of industrial poisons.

At the time the Division of Scientific Research was merged with the National Institute of Health (February 1, 1937), the Office of Industrial Hygiene became the Division of Industrial Hygiene, and Dr. Neal was placed in charge of the research laboratory of the division. When this laboratory became a separate organization within the National Institutes of Health, he continued as chief of the Laboratory of Physical Biology, the position he occupied until his death.

Dr. Neal was noted for his contributions to the field of industrial hygiene and was particularly interested in the fundamental processes involved in toxicology. Specific studies in mercury, manganese, and DDT poisoning were of critical importance to him. He was frequently called on by defense organizations and industry for consultation and assistance. In connection with the Model Safety Code for Industrial Establishments which was being prepared by the International Labor Office, Dr. Neal went to Geneva in the spring of 1949. In this year he was certified as specialist in Preventive Medicine and Public Health (Founders' Group) by the American Board of Preventive Medicine and Public Health. He was also a member of the Joint Subcommittee on Toxicity Screening Methods of the National Research Council Food Protection Committee, Subcommittee on Toxicology, and the Manufacturing Chemists' Association Committee on Chemicals in Foods.

Under Dr. Neal's direction the Laboratory of Physical Biology broadened its attack on fundamental biological problems to research in molecular biophysics, low energy and nuclear radiation biology, and physiological physics. He was author or joint author of more than 100 scientific articles.

He was a member of many scientific societies, notably the American Medical Association, American Public Health Association, American Association for the Advancement of Science, Washington Academy of Sciences, Association of Military Surgeons, American Industrial Hygiene Association, American Statistical Association, American Society of Human Genetics, and Society of Sigma Xi.

Dr. Neal was born in West Point, Tenn., on June 25, 1901. He is survived by his widow, Beatrice M. Neal, his stepson, Alasdair Munro, his two sons, Paul Whitaker and Robert Gordon Neal, his mother, Mrs. Madge Mae Neal, and his sister, Mrs. Ashley Pogue.

MIRIAM LUCILE BOMHARD, range conservationist, U. S. Forest Service, died at her home in Glenshaw, Pa., on December 16, 1952, after a lingering illness. Miss Bomhard was born in Bellevue, Ky., on July 24, 1898, the daughter of the Rev. W. A. Bomhard and Emma Koch Bomhard. The family moved to Pittsburgh in 1907 from Owensboro, Ky. Miss Bomhard graduated from Sharpsburg, Pa., High School in 1917 as valedictorian, entering the University of Pittsburgh in the fall of that year on an honor scholarship. She graduated therefrom in February 1921 with the B.S. degree *cum laude* and in June of the same year received the M.A. degree. One summer was spent at the Cold Springs Harbor, Long Island, Laboratory of Biological Research, and from 1921 to 1925, including summer sessions, she served first as graduate assistant and then as instructor in the botany department of the University of Pittsburgh, meanwhile pursuing postgraduate studies in both botany and zoology. From 1925 to 1926 she was engaged in research work in the Carnegie Museum Herbarium. In 1926 she received the Ph.D. degree from the University of Pittsburgh, the first woman to receive that degree from that university. Her doctorate thesis, which covered illustrations and keys on the identification of seeds of Allegheny County, Pa., plants, unfortunately was never published except in abstract form. In 1926 she was appointed instructor in biology in Newcomb College, the women's department of Tulane University, New Orleans, the first courses in zoology and botany at that college, and in 1927 was promoted to assistant professor, a position she occupied until 1932, when she resigned to go to Malaya and for a trip around the world. Returning to the United States in 1933, at a time when new teaching positions were scarce, she accepted an appointment as junior pathologist in the Bureau of Plant Industry, Washington, D. C., and, from 1934 to her death, was in research work in the Forest Service in what is now the Division of Dendrology and Range Forage Investigations.

Dr. Bomhard was a member of the American Association for the Advancement of Science, the American Society of Plant Taxonomists, the Botanical Society of America, the Botanical Society of Washington (corresponding secretary, 1940), the Ecological Society of America, the International Association for Plant Taxonomy, and the Washington Academy of Sciences. She was a cofounder of the New Orleans Society of Plant Sciences, of which she was secretary in 1930 and president in 1931; also an associate member of the Society of American Foresters. She was an authority on the taxonomy and ecology of United States range plants, especially of the Southeast, and on the taxonomy, distribution, and economic values of palms. Her interest in and knowledge of palms brought her inquiries from all over the world and from defense agencies and others in Washington concerned with important palm products. She served as taxonomist for the Vegetable Oil Mission of FAO in Venezuela in 1948. She was a contributor to the Forest Service *Range plant handbook* (1937) and, in connection with that work, developed a leaf-venation method of distinguishing the highly poisonous waterhemlock genus (*Cicuta*) from the superficially similar innocuous angelicas. Among her more important publications were *The wax palms* (1930), a series of articles on palms in the Louisiana Conservation Review (1937–1939), the palm list in *Standardized plant names* (1942), and *Palm trees in the United States* (1950); she was also coauthor of *Field book of forage plants on longleaf pine—bluestem ranges* of Louisiana (1952). During her earlier days she was a vocalist and sang on the radio. Because of her friendly, intelligent, and vivacious personality, wide travel and correspondence, and her services as guide to the A.A.A.S. meeting in New Orleans in 1931 for world scientists, Miss Bomhard had an enormous acquaintance, and her loss will be widely felt.

W. A. DAYTON